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About Authors

● Dr. A. E. Becker, *after graduating from Marietta College with an A.B. degree, magna cum laude, in 1909, where he was also a member of Phi Beta Kappa, continued his studies at Harvard University and graduated with his Master's degree, in 1910. Teaching attracted him and for one year he was instructor in physics at Tufts College, 1911-1912. He returned to Harvard as assistant physicist and stayed there until, in 1917, he was awarded a Ph.D. in physics. That year he joined the National Advisory Committee for Aeronautics and in 1918 entered the Army. After the War he became physicist for the Aluminum Castings Co. Since 1920 he has been with the Standard Oil Development Co. Dr. Becker joined the Society in 1928 and has presented a number of papers before its membership. In 1933 he served as SAE vice-president, representing the newly organized Fuels and Lubricants Activity and he has been an active member of many of the Society's technical committees.*

● Richard S. Buck *has been with Pratt & Whitney Aircraft since his graduation from the Rensselaer Polytechnic Institute in 1927. As test engineer and later project engineer he has conducted the development of many different projects, including single cylinder research, double row engines, and fuel injection, as well as the torque indicator. At present he is in charge of supercharger development. He is a native of Hartford, Conn.*

● W. J. Cumming *dates his connection with the automotive business from the time he was doing War work for the Newark Trailer Corp. This field since claimed all of his time as designer, engineer, service manager, and more recently in a job that combines the above—fleet operator. Following important technical positions with the old Seldon Co., Bessemer Motor Truck Co. and the Garford Motor Truck Co., he took a leading part in the pioneering work of the Goodyear Tire & Rubber Co. in developing the six-wheel vehicle. This project required five years, after which Mr. Cummings was with International Harvester for a short time before joining the Six-Wheel Co., which was building the type of vehicle Mr.*

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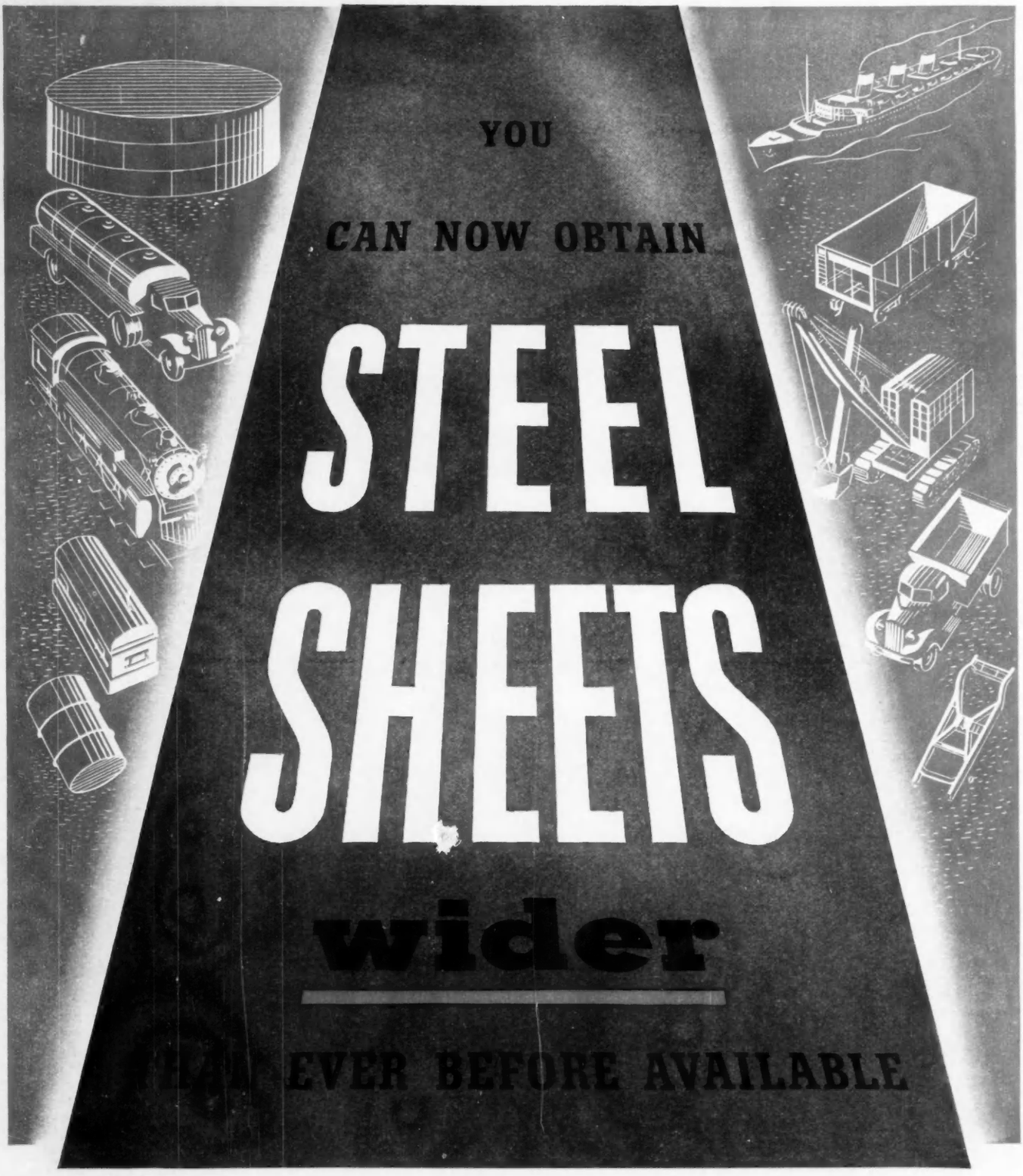

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"Best-To-Come" Theme Dominates All Annual Meeting Sessions

BIG things happened at the 1938 Annual Meeting of the Society in Detroit Jan. 10-14.

A new factual basis was laid for cooperative thinking between motor-vehicle administrators and automobile engineers. Transition from purely individual brilliance to group action as an essential in future automotive engineering progress was emphasized by Charles F. Kettering. Elements of a scientific attack on the legislative problem of legal requirements for truck performance were thoroughly aired. The possibilities of the Diesel as a high output aircraft engine were exposed by experts of the National Advisory Committee for Aeronautics. Current progress in automotive manufacturing methods was frankly appraised . . . and crowds of engineers packed themselves into meeting rooms throughout the week to pile up another new session-attendance record following the 1937 high.

If there was a recession going on somewhere, nobody in the Book-Cadillac SAE sessions had time to worry about it. They were all too busy tossing back and forth ideas about how to do practical things better than to bother about stock market intangibles. Envisioned was an airplane taking off, flying and landing – the whole performance completely automatic. Methods of eliminating air traffic congestion were outlined. New piston ring surfacing to increase life was explained in a paper read in perfect synchronism with motion pictures illustrating each point made. Full reports of the vital work of the Cooperative Fuel Research were presented.

Aside from the keenness and vigor of the discussion at every one of the 18 technical sessions, an outstanding feature was the crisp handling of these gatherings by the various chairmen and the effective personal presentations by the speakers. In each of these respects, the average was unusually high. The inevitable result was a fast-cracking meeting. Important among the numerous actions taken in the 45 committee meetings held during the week were completion of final programs for the special three-day National Passenger Car Meeting scheduled for Detroit March 28-30 and for the two-day National Aeronautic Meeting which takes place in Washington, March 10 and 11.

Kettering Looks Ahead

Speaking at the dinner on Jan. 13, C. F. Kettering told the engineers that we are going through a transition period.

"The inventor of yesterday cannot be the inventor of tomorrow," he declared, "because we now have to substitute a group for an individual. On many problems we may have to have a physicist, a chemist, an engineer and a biologist. The hardest problem is to get such highly technical specialists to work as a group.

"The young engineers," he continued, "often seem to feel that they haven't much opportunity. They become discouraged – because they don't understand the gentle art of failing. . . . The only time you don't want to fail is the last time you try!"

Packed with typical Kettering aphorisms and sharp humor, this dinner talk brought the crowd to its feet cheering in appreciation. (See page 15.)

Mr. Kettering paid high tribute to the SAE and its members when he said: "There is less personal 'I am' in the SAE and more cooperation than in any other technical organization under the sun. We know how to work together. We know how to get along together. We know how to fight together. That is why our 33 years of past history has been the progressive thing that it has."

President Spicer Speaks

Newly-elected President C. W. Spicer stressed the same thought in his inaugural address which preceded Mr. Kettering's talk at the dinner, when he said:

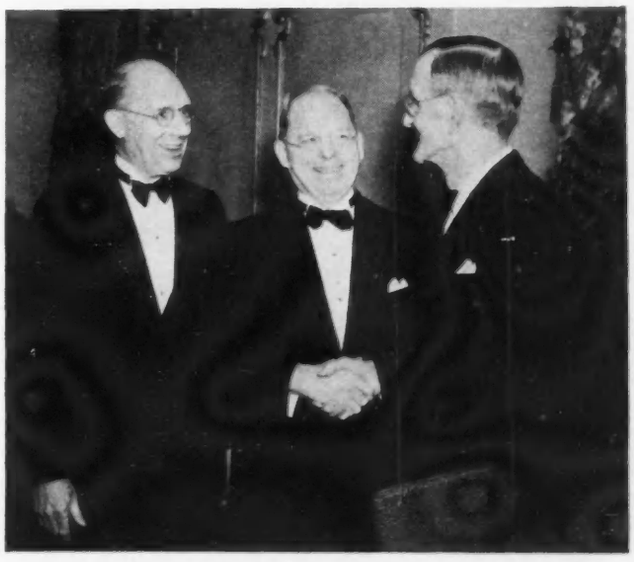
"The chief thing to be sought is cooperative action to benefit the individual as well as the group. Since its very beginning, the SAE has prospered on a foundation of doing a good job for its members – and for the industries in which they work."

Mr. Spicer stressed the fact that the automotive and railroad fields have many interests in common and urged that greater cooperation between the two will result to the advantage of both.

"The railroads already have efficient technical organizations," Mr. Spicer said in pointing to the increasing use which modern railroading is making of internal combustion engines, light-weight construction and other items that parallel the work of the Society of Automotive Engineers.

"It seems possible that automotive experience will be even

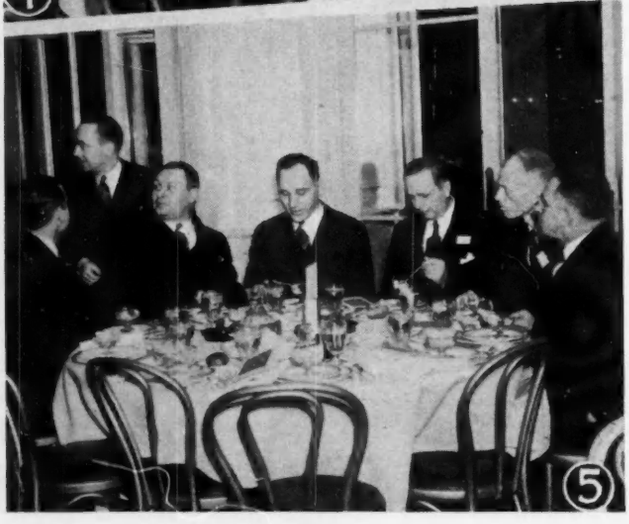
Past, Past and Present



President C. W. Spicer is congratulated by retiring President Harry T. Woolson, while dinner-speaker Past-President C. F. Kettering looks on.

Banquet Brings Old Friends Together

1. G. W. Sande, H. G. Fales, E. W. Upham, W. H. Graves
2. William Fairhurst, J. E. Padgett, L. A. Chaminade, R. E. Carpenter, R. V. Hessler, H. E. Simi
3. G. W. Carlson, W. D. Reese, H. D. Mixer, J. R. Bartholomew, A. D. Gardner
4. R. Minke, M. A. Thorne, A. T. Colwell, M. P. Graham
5. A. O. Koceja, E. P. Lamb, B. Steenson, H. G. Kamrath, C. S. Brownlee, T. S. Kemble, E. W. Dilg



more useful in the railroad field in the future than it has been thus far. Much of the development of the light-weight, high-speed, streamlined trains which we have heard so much about is the product of companies which were pioneers in the all-metal bodies, that are now standard automotive construction," he stated. "Automotive experience," he pointed out, "has also had some effect in the design of the Diesel locomotives which draw these high-speed trains. Much of the air conditioning in the railroad field is being done by subsidiaries of automobile companies, while propeller shafts and gear units similar to those of automotive practice are used to drive the lighting generators and air-conditioning equipment. The automotive and railway fields are far from being separate and distinct, but on the contrary have many interests in common."

Retiring President Harry T. Woolson emphasized the national aspects of the Society in a brief valedictory and pointed to the variety of constructive work possible of accomplishment on a broad national scale which would be impossible if attempted by circumscribed or sectional groups. He expressed his appreciation for the cooperation given during his administration by the Council, the headquarters staff and the membership at large.

Detroit Section Chairman F. F. Kishline, chief engineer of Graham, was toastmaster. The dinner – for members only this year – was sold out three weeks before it took place.

Future Visioned for Students

Particular interest centered on the Junior-Student Session this year in view of the recent Council action setting up for the first time a national Student Committee to stimulate and coordinate the growing Society work in this field. This annual meeting session was arranged and conducted by A. C. Hazard, chairman of the Detroit Section Student Committee, and brought out nearly 400 to hear Roy H. Faulkner, vice-

president, Cord Corp., and to see demonstrations of recent scientific advances by E. L. Foss, General Motors Corp. Research Laboratories.

"Opportunity ahead for the young engineer today is just as great as it ever was," Mr. Faulkner told the group.

"Success for the engineer of the future," Mr. Faulkner said, "rests upon the same basis as did success for engineers in the past. The man who makes big sums of money must pay the price of success," he declared, "and always will have to." He asked engineers not to be temperamental, to climb upward with their shoulders under the heels of others, and to find satisfaction in contributing a single part of a successful design.

"Make friends," he urged in closing. "No matter which way the tide may take you – to success or failure – you will find yourself rich indeed if you can say: 'My friends are true – and they are legion.' "

Mr. Foss presented demonstrations illuminating the fundamentals of recent scientific advances pointing to the practical probability of the Faulkner prediction. Mr. Foss' previews of progress included simple demonstrations involving the development of the internal combustion engine, changing sound into light and light into sound, and numerous experiments explaining modern scientific discoveries.

Passenger-Car Sessions

Tuesday Evening **Norman Damon, chairman**

The Motor-Vehicle Administrator Looks at the Automobile **– C. A. HARNETT, Commissioner of Motor Vehicles, State of New York.**

Wednesday Morning **L. L. Williams, chairman**

Air Conditioning of Automobiles and Buses, Winter and Summer **– L. W. CHILD, Evans Products Co. E. H. Smith, chairman for discussion.**

Wednesday Afternoon **W. C. Keys, chairman**

New Technique for Noise Reduction **– DR. E. J. ABBOTT, Physicists Research Co.**

A COMPOSITE of what state motor vehicle administrators think of the modern motor car and how it can be improved from the safety standpoint was presented by Commissioner Harnett.

This unusual opportunity for automotive engineers to learn what so important a group of public officials think of their products, resulted from an invitation extended by the Passenger Car Activity Committee to the American Association of Motor Vehicle Administrators to name a speaker to present its views at the Society's Annual Meeting. The Association immediately undertook a questionnaire survey of its members' viewpoints and received replies from 42 administrators. In the main, the paper presented by Commissioner Harnett, who was designated to speak for the administrators by Ray Ingels, Director of Motor Vehicles, California, and President of the Association, was a report on this survey.

At the outset, the Commissioner stressed that his paper did not represent the findings of technical experts based upon exhaustive tests, but rather the views of men actively engaged in the motor vehicle safety field and who are in constant contact with automobile use on the highways.

After paying tribute to the steady and remarkable improvement in motor cars and pointing out that accident avoidance was 95 per cent in the hands of the driver, the Commissioner said that: "This does not weaken the fact that automobiles can be made safer." Although the paper covered many aspects of automobile design, the three points which the administrators stressed were headlights, speed, and visibility.

A majority of the administrators considered present headlamps unsatisfactory. The vote on three- and two-beam systems was 20 to 18 in favor of the former, whereas 24 contended that passing beams do not reduce glare sufficiently with 17 taking the opposite position. On bulb candlepower, the administrators in the main simply reported the legal requirements in their states. Commissioner Harnett expressed his personal opinion on what we needed for light for night driving. Only a few expressed opinions on beam candlepowers.

Commenting on this point, the speaker said: "I think that, until it is shown satisfactorily that higher maximum candlepower is a necessity, headlamps should continue to be designed with the 50,000-cp. limit. If additional light is made available through increased bulb candlepower, it should be spread out rather than be used for higher maximums."

Commenting on the headlighting problem in the discussion, J. H. Hunt, General Motors Corp., said that it is impossible to provide enough light for the average person to drive safely

What Kettering Said

"I really have a kindly feeling for our politicians. Man tried mechanical perpetual motion and electrical perpetual motion and it just pretty near worked. Now the boys are trying for economic perpetual motion – and that isn't going to work either. . . . .

"A representative of an educational survey organization told me that a survey shows that, next to the coal industry, the automotive industry employs fewer technical people than any other industry. I said: 'I won't dispute you. You know and I don't. But accepting what you say as true, what is wrong with the technical graduates of your educational system that we can't use them'? . . . .

"Individual transportation has been developed by people who were not too scientific; who didn't know too much – but who didn't know the thing wouldn't work and tried it. That is the spirit we don't want to lose as we get older. . . . .

"You learn more by the accidents you have in research than in any other way. You have to move around to have an accident. You don't have many standing still. I would rather have unintelligent action than intelligent standing still. . . . .

"One thing we automotive engineers have on the scientific physicists. We know more that we don't know than they do! . . . .

"I'm going to take up a collection to build a library to house the books we haven't got – and it is going to be a big one. We are all the time going back and looking into the books we have got, instead of trying to see if what we need isn't in some of the books we haven't got. . . . .

"Progress will continue as long as we have faith enough, as long as we are willing to learn, as long as we don't get too egotistical and as long as we recognize there are a lot of things we don't know. . . . .

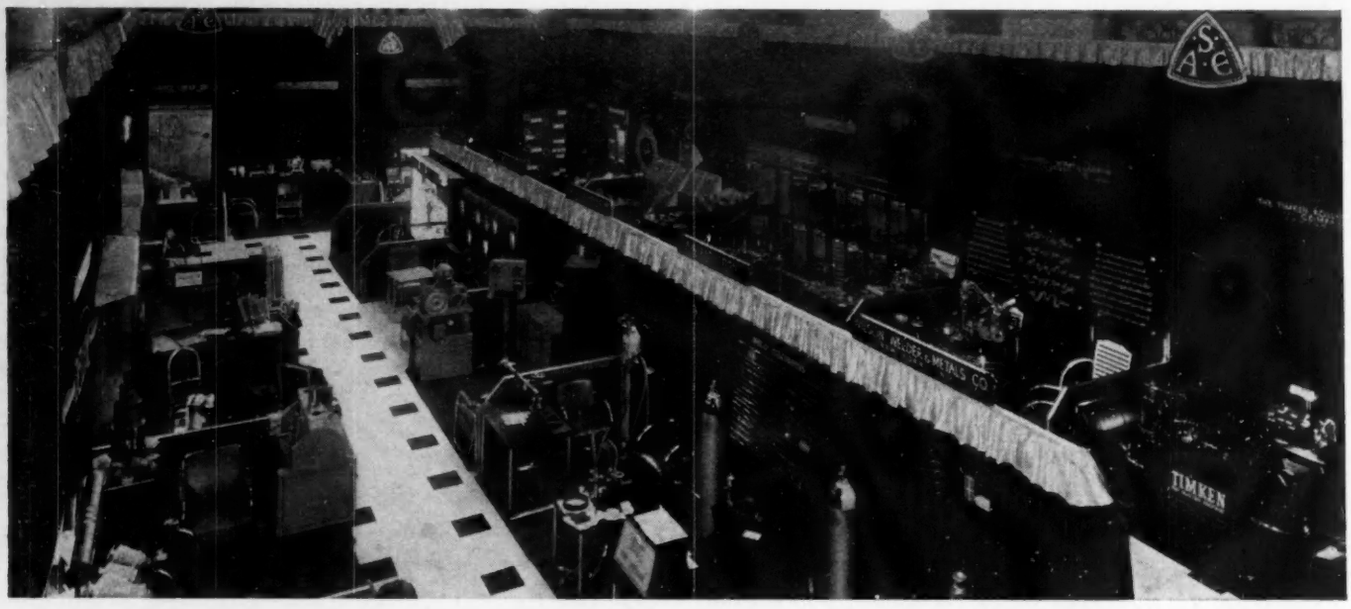
"When we lay our ignorance sheet on the table, people contribute. When we lay our egotism on the table, people leave us. . . . .

"When a man says: 'This is a difficult problem,' he really says: 'I am a soft drill on a hard piece of steel.' . . . .

"It isn't research if you know how it is going to work. . . . .

"There is something new in the world. It only depends on our imagination whether the million things yet to be done come true."

Up and Down the Aisles of the Main Exhibition Hall



In addition to the room shown above, numerous other technical products were displayed by manufacturers in adjoining corridors and rooms. Nowhere was the spirit of optimism which dominated the entire SAE Annual Meeting more in evidence than in the booths of the Engineering Exhibit where engineers of supply companies met engineers of vehicle manufacturing and operating units to exchange information about the variety of new products and processes which were shown.

This year the companies exhibiting were: Acheson Colloids Corp., Air Reduction Sales Co., Aluminum Aircell Insulation Co., Aluminum Co. of America, Baldwin-Southwark Corp., Campbell, Wyant & Cannon Foundry Co.,

at more than 35 m.p.h. without glare because the beam must be aimed so low. Continuing, he expressed the belief that relaxation of present legal limitations would permit improvements in headlamps that would make 50 m.p.h. safe. On beam candlepower, he said that, if we admit that we can't drive safely over 35 m.p.h. with the driving beam aimed so that it does not glare then, with the driving beam aimed higher for safe seeing at moderately higher speeds, with either 50,000 or 75,000 cp. in the beam, glare interference will be such that the passing beam must be used for relief. Hence adherence to the 50,000-cp. limit means a reduction in seeing distances without any compensating gain in the form of glare relief.

On the question of speed, Commissioner Harnett said that: "It is highly significant that not one of the 42 administrators felt that the present-day car had insufficient speed . . . whereas 27 expressed views that present-day cars have too much speed." The majority of administrators voted against the use of governors as a means of controlling speed, he reported.

Commenting on the speed question, the Commissioner expressed the conviction that the increase in automobile accidents was due to the ease with which relatively high speeds are attained and the exacting demands which are made on the nervous system of the driver. As a solution he recommended removal of unnecessary reserve power and educating drivers in the dangers of speed that is too fast for conditions.

The importance of speed was conceded by W. S. James, Studebaker Corp., in the discussion. He said that it was undoubtedly true that "speed too fast for conditions" was a factor in most accidents. He pointed out, however, that this expression is too frequently interpreted to mean high speed whereas, in a particular accident, anything from 5 to 80 m.p.h. might be too fast for the conditions. Consequently, Mr. James pointed out that until we had the facts to establish whether the problem was high speed or the injudicious use of speed, conclusions were hardly justified. He also stated that automobile top speeds had been about constant for the last three years and that talk of 100 m.p.h. cars was mostly conversation as few if any cars could actually make that speed on the road.

Dr. H. C. Dickinson, National Bureau of Standards, also discussed the speed problem emphasizing that the problem is not to determine what is a safe speed, but what speed is safe for the conditions.

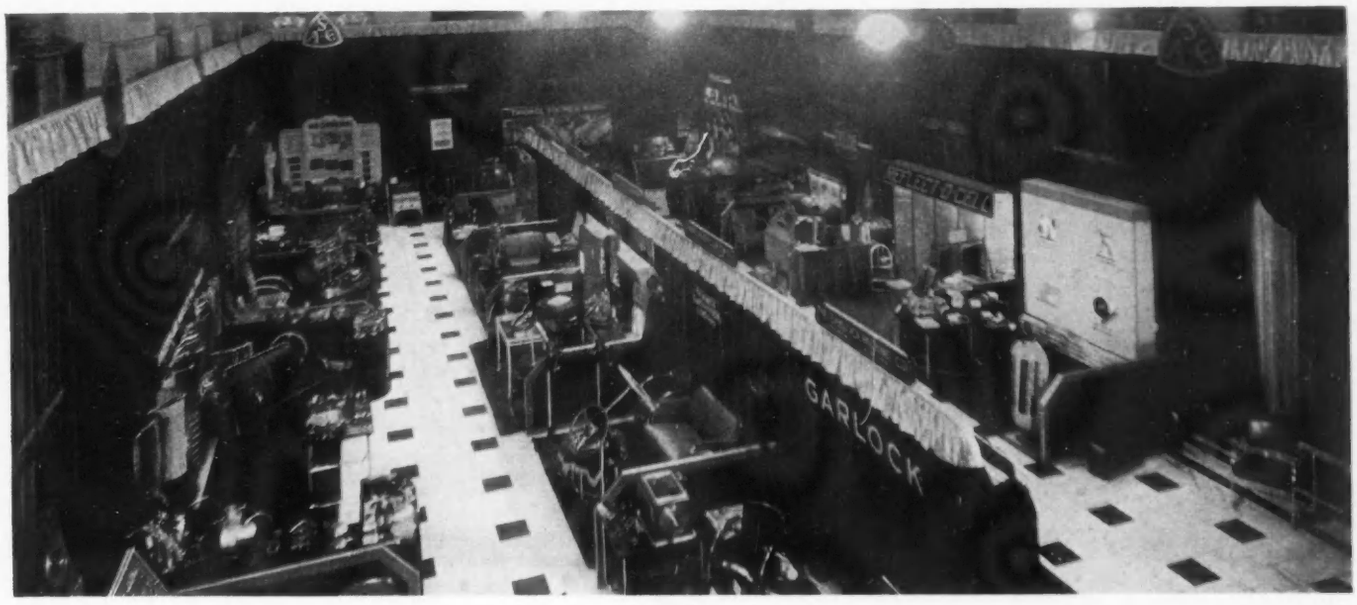
D. Grant Mickle, chairman of the National Safety Council Committee on Speed and Accidents, expressed somewhat the same viewpoint when he said that we can probably learn what speeds are too fast for what conditions, but that the real problem is informing the public.

Reverting to Commissioner Harnett's paper, on the question of visibility, the majority of administrators favor vertical adjustment of the driver's seat. A majority are critical of the heights of hoods and many of them commented unfavorably on divided windshields and rear windows and on the small size of the latter. The Commissioner also placed considerable emphasis on the improved visibility that would result if the engine were placed in the rear.

Discussing visibility, President Harry T. Woolson said that he sometimes thinks that if we had started with the engine in the rear, we might now be trying to move it to the front. He pointed out, as did J. H. Hunt, that locating the engine in the rear also would react unfavorably on handling characteristics because of the weight distribution. In present cars, he said that the trend in styling had operated to reduce visibility as compared with older cars and that a change in the style trend might bring improvement in this connection. He pointed out, however, that current designs have been well received by the public, judged by sales.

In concluding his talk, Commissioner Harnett said that he regarded the invitation to speak as a splendid opportunity to promote a closer contact between the men who design and make motor cars and the officials who are responsible for their safe use on the highways. Somewhat the same sentiments

Of the Fifth Successful SAE Engineering Exhibit



Cities Service Co., Cleveland Graphite Bronze Co., DeLuxe Products Corp., Doehler Die Casting Co., Dole Valve Co., E. I. du Pont de Nemours & Co., Inc., Fleming Manufacturing Co., Inc., Ford Motor Co., Garlock Packing Co., Gemmer Manufacturing Co., Hercules Motors Corp., International Nickel Co., Koppers Co., Monroe Auto Equipment Co., J. W. Mortell Co., Motor Improvements, Inc., Ohio Crankshaft Co., Perfect Circle Co., Rohm & Hass Co., Spicer Manufacturing Corp., Sunnen Products Co., Thiokol Corp., Timken Roller Bearing Co., United American Bosch Corp., Victor Manufacturing & Gasket Co., Waukesha Motor Co., Wilson Welder & Metals Co., Wyman-Gordon Co., S. S. White Dental Manufacturing Co., and Zollner Machine Works.

were expressed by Sidney Williams, National Safety Council, who stated that he had heard it said that engineers were interested only in designing cars without caring much what happened to them afterward. If that had ever been so, he continued, this Safety Session was evidence that it was no longer true.

That air conditioning of automobiles and buses is no simple problem was definitely shown at the Passenger Car and Body Session. However, Mr. Child's paper and the discussion it created gave every indication that it won't be long before it will be quite the common thing to step from an air-conditioned home into an air-conditioned car and drive to an air-conditioned office.

Car Air Conditioning Advancing

Early in his paper Mr. Child blamed the advertising man for the public's belief that air conditioning is synonymous with cooling. So that every one hearing his paper would have the true concept of the term, he quoted the definition arrived at by the Heating and Ventilating Engineers, which is: "Air conditioning is the science of controlling the temperature, humidity, motion, and cleanliness of the air within an enclosure."

From a safety point of view, he declared, air conditioning is most important in winter to prevent fogging of windshields and windows. This, he explained, is caused by the increased amount of water vapor in the air due to that given off by the passengers, and can only be eliminated keeping the amount of water vapor in the air low enough to prevent condensation at the temperature of the glass. He said that to do this requires about 90 cu. ft. of fresh air per min. when there are five passengers in the car. Since a blast of cold air is not exactly comfortable, he continued, it is logical to add enough heat to the incoming air to heat the car. On a zero day, he computed, it is necessary to add 128 cu. ft. of air per min. heated to 140 deg. fahr. to maintain a temperature of 70 deg. fahr. in a car traveling 50 m.p.h., carrying five passengers.

Complexities increase when air conditioning buses, the author pointed out, as the number of passengers may vary from none to 40 or more, and the bus may run with doors opening and closing frequently, or infrequently, and may be in the shelter of buildings or in a wind-swept stretch. These conditions, he said, call for a very flexible system of thermostatic control, and from a health standpoint alone, call for plenty of fresh air.

In summer, the author stated, the problem of maintaining proper conditions inside a vehicle is approached in the same fundamental manner as the winter problem, except that heat is removed rather than added. He pointed out that in summer clear vision will not generally be affected by humidity, and therefore the amount of humidity desired will be based upon comfort alone. One of the many factors to be considered is that each passenger will give off about 260 B.t.u. per hr. at 80 deg. fahr. and 45 per cent air. Other problems are the varying temperatures in the car according to location and speeds of the car.

Before closing his paper, Mr. Child made the remark that the average human cannot make up his mind whether it is the heat or the humidity that is causing his discomfort, and for that reason the summer system must be automatically controlled. This is not as simple as might be imagined, he added.

At the close of Mr. Child's paper, Chairman Williams introduced Frank S. Spring, 1938 vice-president of the Passenger Car Body Activity, who presided at a short business meeting. Mr. Williams then introduced Earl H. Smith, who took over the session as chairman of discussion.

R. F. Norris, C. F. Burgess Laboratories, Inc., was first to answer the call for discussion. It is irking, he said, to see a "chicken coop" out in front of the car when it is so hard to get space in the middle for the installation of air-conditioning equipment. He then described the equipment with which his company is experimenting. One of the most interesting points, he said, is that it requires a double windshield that absolutely eliminates fogging in winter as the warmed air

passes through it. The passenger compartment is heated or cooled by air gently coming from ducts in the top and passing out through a vent located under the driver's seat. He noted also that there are from 3½ to 4 air changes per min.

Mr. Norris questioned the advisability of automatic control, stating that people never know that they are comfortable until they have been uncomfortable.

H. E. Simi, Twin Coach, emphasized that because of varying design and service, city-type buses must have extremely flexible heating and ventilating equipment. He also remarked that it must be highly efficient and that cost is an important feature. Some operators, he said, want air from the roof instead of the window level and he wanted to know if any studies have been made to show the difference in air strata as to contamination.

In reply Mr. Child said that while he had no data, it is undoubtedly better to have the intake as high as possible. New York City, he said, demands that air be taken from the top and front of a bus.

Answering a direct question from Mr. Spring, Mr. Child stated that the complete weight of the air-conditioning equipment described in his paper would be in the neighborhood of 55 lb.

Additional factors in air conditioning were brought out by William I. Stieglitz, Barkley-Grow Aircraft Corp., who mentioned that the car driver is not as sensitive to draft as other passengers because he is working, and that he is also giving out more B.t.u. than a person at rest. He also mentioned that a passenger's clothing soaked by rain would add to the amount of water vapor in the car.

F. J. Linsenmeyer of the University of Detroit agrees with Mr. Norris that it is not necessary to have an automatic control system in the summer. He also believes that a scoop can supply all the air needed at average driving speeds.

Noises were prevalent at the Passenger Car Noise Session. They came from demonstrations Dr. Abbott used to drive his points home in such a way that one of his listeners was heard to say, "To *hear* is to believe." Interest was so great in Dr. Abbott's presentation that the audience applauded Chairman Keys when he extended the speaker's time beyond that allotted on the schedule.

How to Reduce Noise

Early in his talk Dr. Abbott stated that quieting noise is the easiest part of the noise problem; the real difficulty comes in diagnosing causes of noise. Since that latter had been discussed in an earlier paper* Dr. Abbott strictly confined his remarks to noise reduction.

After demonstrating that it is necessary to reduce noise pressures and vibrational velocities to ½ or ⅓ of their initial values before the listener notices a definite improvement, he showed further that to reduce a noise (velocity or pressure) 50 per cent it is necessary to remove a component which has an individual value equal to 87 per cent of the original total.

Dr. Abbott then described seven methods of noise reduction, most of which he demonstrated.

The first had to do with the reduction of the noisemaker's ability to vibrate the air, which might be done by any one of the following: stiffening; adding weight; adding friction to reduce movement of parts; or interposing resilient means, such as rubber mountings, between certain moving parts and certain other parts which are being caused to vibrate.

The second method is to reduce the amount of radiation resistance, which he said can be more simply stated as reducing the amount of air shaking. This is possible by making the dimensions of vibrating parts smaller than the wave length of the sound being radiated. At 1000 cycles per sec., he explained, the wave length is about 1 ft.; at 100 cycles per sec. it is about 10 ft.

The third method described by Dr. Abbott is to enclose the noise maker in a heavy, air-tight, non-vibrating enclosure. He particularly emphasized that such an enclosure should be made of a very poor sound absorbing material.

In discussing acoustical absorption, the fourth method, Dr. Abbott stated that sound-absorption material has many uses and is most effective when a large fraction of the sound is reflected many times. He noted that it is not suitable for a partition.

Speaking of the fourth method, mechanical damping resistance, he said that it can effectively reduce only resonances and occasional, or transient, noise-producing disturbances such as occasional impacts.

The sixth and seventh methods had to do with obtaining greater accuracy of parts and shifting frequencies to less objectional ranges. The first of these is apt to be costly, the author said, advising that it be considered as a last resort when there is definite evidence that it will produce the desired result at a reasonable cost. Shifting of frequency is not usually practical when dealing with machinery noises, he said.

In concluding his paper, Dr. Abbott gave three examples of practical quieting in which he had a part.

Chairman Keys in complimenting Dr. Abbott on his paper referred to him as a "theoretician gone practical." He then opened the meeting for discussion by calling on W. A. Wagstaff, of Norge.

Mr. Wagstaff asked three things of acoustical engineers and scientists: first, that they effect an agreement among themselves as to theories, terms, units of measurement, and descriptive items of acoustical science so that the production of acoustical expert engineers in our universities and laboratories can be made as simple, positive and effective as is the case at present with mechanical or electrical engineers; second, that they simplify and standardize noise analyzing instruments and make them less expensive; and, third, that they further improve the technique for analyzing noise problems so that a complete analysis and correction of any noise problem can be made in a day or two, rather than in several months.

More technical was the discussion submitted by Stephen J. Zand, Sperry Gyroscope Co., Inc., who spoke particularly of noise reduction in an airplane cabin. He expressed the problem as either decreasing noise transmission or increasing noise absorption, or doing both in proper balance, reminding the audience of the premium of weight in anything dealing with airplanes. He also spoke of a newly-developed system of sound absorption developed by John Parkinson of Johns-Manville and the Sperry staff which is a combination of two materials which weigh very little and show remarkable sound absorption in low frequencies. The construction, he said, consists of a highly stretched diaphragm which can be made of any material impervious to air, behind which felt is located; the thickness of the felt varying with the amount of absorption wanted and with the limitations of weight. For full effectiveness this construction should be spaced from the surface behind.

Referring to Mr. Wagstaff's remarks Mr. Zand asked "How expensive is expensive?" He said that his instruments cost about $5,000, which might seem high to an instrument purchaser, but which doesn't seem so high when compared to a page of advertising costing $3,000.

Discussion by John Parkinson, of Johns-Manville, read by the chairman, called attention to the value of damping materials for quieting door noises and certain types of road noises such as produced by crossing expansion joints in concrete. He

*"The Place of Sound Measurements in Automotive Noise Reduction," E. J. Abbott, SAE JOURNAL, TRANSACTIONS SECTION, p. 271, Aug., 1934

Members From Far and Near Meet at Banquet

1. David Beecroft, Furber Marshall, D. L. Gallup
2. W. H. Ragsdale, D. W. Randolph, E. F. Bacon
3. W. B. Hurley, Glenn Coley, G. L. Neely
4. K. L. Herrmann, C. T. Fishleigh, Herbert Hunting
5. W. A. Taussig, Pierre Schon, T. C. Smith, Harry B. Dodge, F. L. Faulkner, W. J. Davidson. *In foreground*, John M. Orr
6. F. W. Marschner, C. D. McCall

also amplified Dr. Abbott's remarks regarding the effect of sound-absorbing material, quoting instances where it has proved of considerable value.

R. F. Norris told of his company's experience in developing a telephone booth, satisfactory in keeping outside noises from the person telephoning although only enclosed on three sides. E. A. Tulus, Kelvinator, spoke of the desirability of removing the components of very high frequency that bother us, even though decibels are not reduced. He also favorably mentioned sound damping materials that have both friction and mass. Another speaker, G. T. Stanton, Electrical Products, Inc., stated that there is a movement under way to standardize acoustical instrument readings. He also voiced the opinion of other discussers in speaking of the importance of reducing noise. It has an economic value that, in most instances, warrants the time expended in its consummation, he said, even if it isn't done in a few days as asked by Mr. Wagstaff. W. H. Tucker, of the Hoover Co., spoke of advances in noise reduction made in the manufacture of vacuum cleaners, despite the fact that improvements, such as increasing the r.p.m. of the motor, decreasing weight, and increasing nozzle-suction, all work against it.

Interest in the subject carried the discussion until well past closing time.

Aircraft Sessions

Monday Morning **Peter Altman, chairman**

Practical Aerodynamics **– DR. ALEXANDER KLEMIN and E. B. SCHAEFER, New York University.**

Use of Generalized Logarithmic Graphs for the Calculation of Airplane Performance **– IVAN L. DRIGGS, Glenn L. Martin Co.**

Monday Afternoon **F. E. Weick, chairman**

Air-Track System of Aircraft Instrument Landings **– G. L. DAVIES, Washington Institute of Technology.**

Radio Controlled Automatic Landings **– CAPT. G. V. HOLLOMAN, Wright Field.**

RESULTS of recent wind-tunnel experimentation of the type that often is kept secret; a short method of finding airplane performance that saves days of tedious calculation; design and operation of a completely portable system of aircraft instrument landing; and a progress report of the status and future possibilities of automatic blind landings and automatic aircraft control, were disclosed in four papers in the Aircraft Sessions.

Big Guns Bring Problems

Rapid adoption of large aircraft guns has made it necessary to solve the aerodynamic problems incident to their use, Dr. Klemin explained, as co-author of the first paper. Without the provision of a special enclosing turret, wind-resistance forces and moments become so large as to impede the handling of the gun so much, he continued, that the gunner is unable to train on a target by manpower alone. As balancing vanes only partially solve the difficulty, complete enclosure in a specially designed turret is desirable, he concluded.

In spite of the aerodynamic superiority of the monoplane, the biplane still retains its usefulness for certain aircraft types, Dr. Klemin pointed out, reporting results of another investigation. Tests on a biplane with large stagger and positive decalage showed a high degree of static longitudinal stability with a minimum area of horizontal tail surfaces, he announced.

Concluding a discussion of wind-tunnel tests on the Gwinn Aircar, an original-design private biplane, and the Gwinn flap, Dr. Klemin opined: "It is quite apparent that a reasonable well-thought-out approach to the private plane has been made, and that the staggered biplane has possibilities for the small, private machine just as it has for the primary training plane.

"The only practical and important conclusion," reported Dr. Klemin from a study of the air resistance of the housing for loop antennae, "is that the housing of the loop antennae in a tear-drop or airship form is definitely preferable from an air-drag point of view."

As his last topic, Dr. Klemin discussed test results that shed light on how the interference of component parts affects static longitudinal stability.

The importance of the Reynolds number used to obtain the stability curve was stressed by Fred E. Weick, Engineering and Research Corp. "I do not believe that it condemns small wind tunnels in any way," he said, "to point out that, when dealing with burbling flow and boundary layers, large Reynolds numbers in full-scale tunnels give the truer picture."

A request for information on the method of filleting used to eliminate jamming effect between the nacelle and body, made by William Stieglitz, Barkley-Grow Aircraft Corp., drew two answers. Mr. Driggs discussed the results of private tests and Chairman Altman reported that he experienced this jamming no matter how much filleting was employed.

J. H. Geisse, Bureau of Air Commerce, emphasized the desirability of controlling with flaps rather than by changing the angle of attack.

Graphs Slash Routine Work

"Performance calculations that used to take two or three days can now be done in several hours by means of the logarithmic graphs described," was Mr. Driggs' introduction to his paper.

All previous short methods of finding the performance of an airplane by means of simple formulas or charts suffer from certain limitations and errors when applied to modern airplanes with constant-speed propellers and supercharged engines, he contended.

"The ideas presented in this report, however," he announced, "are designed to eliminate all the faults of these earlier methods and to provide a means which will be satisfactory for all types of propellers, airplanes, and engines."

By a simple device employing two parameters determined by the dimensions of the specific airplane, he explained, the power-required curve is generalized and then plotted logarithmically, and the power-available curve is likewise generalized and plotted. Then, by a simple calculation, the method of placing these two generalized curves one over the other is found, he continued. The values from which the performance can be obtained can be read directly from the graphs with no plotting, Mr. Driggs concluded.

"Mr. Driggs' figure of two or three days to calculate an airplane's performance is optimistic," remarked Dr. Stephen J. Zand, Sperry Gyroscope Co., Inc., "it takes me about four days," adding that he will lose no time in starting to use the new method.

Performance obtained by these graphs compares with actual performance the same as does that found by the long method of computation, was Mr. Driggs' reply to Dr. Zand's query.

Calling attention to the importance of the human element in using the new method, Ralph H. Upson, consulting engineer, pointed out that the experience and intelligence of the operator of the graph method would bear heavily on the speed and accuracy of the results.

Congested Air Traffic Seen

"The first instrument landing in history was made at Mitchel Field on Sept. 24, 1929, by Lieut. James H. Doolittle, using the system devised by the Bureau of Standards in 1928, a forerunner of the present "Air-Track" system of aircraft instrument landing," recalled Mr. Davies reviewing the development of instrument landing. This system used a visual radio range beacon as a runway localizer and a marker beacon to indicate the end of the field for longitudinal guidance, he explained.

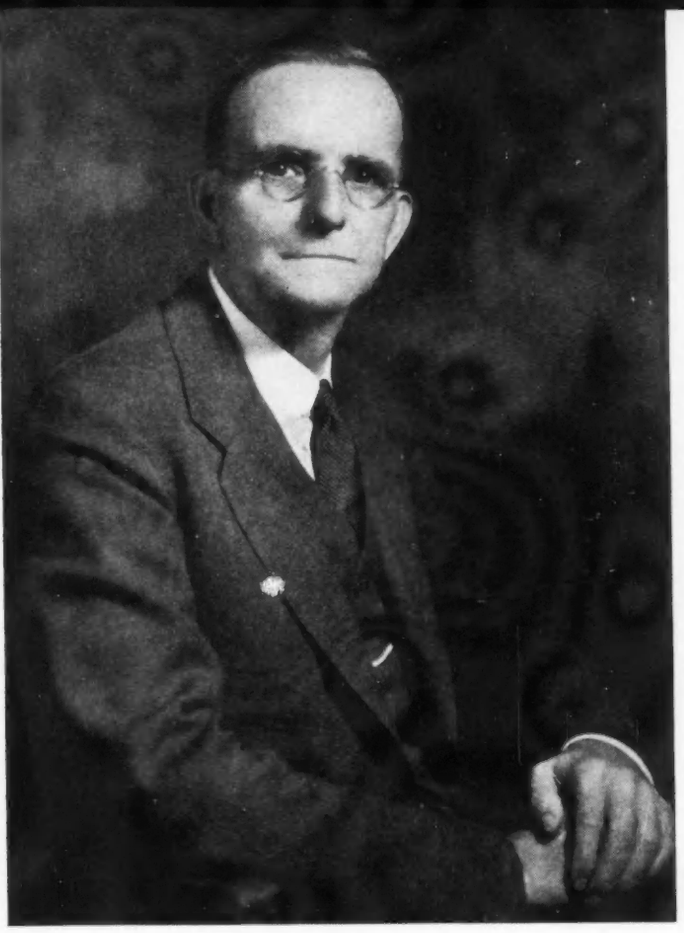
In 1933 a group of engineers of the Bureau of Standards joined another group of the Washington Institute of Technology to continue development of the Bureau of Standards system and to adapt it for commercial use, Mr. Davies continued. The result of this cooperative work is the Air-Track system, a completely portable system that can be run onto any airport and set in operation in about 20 min., he announced.

The system not only meets the specifications set up by the airlines, he pointed out, but includes some features defined by them as desirable future developments.

Regularity of service comparable to that of railroads is further in the future than it seems at first glance, Mr. Davies believes, on account of traffic congestion and the danger of collision in the air. He then told of various methods that are

(*Continued on page* 25)

Officers for 1938



President C. W. Spicer

CLARENCE W. SPICER established himself in the automotive industry back in 1905, when, just a year after completing the mechanical engineering course at Cornell, he organized and became president of the Spicer Universal Joint Manufacturing Co. Before that he had been working on the development of universal joints and had headed a small company manufacturing them. From 1910 until 1916 he was president of the Spicer Manufacturing Co. In the latter year the company was reorganized as the Spicer Manufacturing Corp. and Mr. Spicer took office as vice-president, continuing in that capacity to date. He holds numerous universal-joint patents and development of the hydraulic press type of "push" broach for square and multiple splined holes, and a gear drive for railway-car lighting generators and air-conditioning equipment are among his contributions to other industries.

During the War, Mr. Spicer was in the corps of designers responsible for the Class "B" Liberty Truck.

In recent years Mr. Spicer has been much interested in various applications of automotive engineering to railroad equipment. In his inaugural address at the 1938 Annual Meeting he voiced his conviction that "the automotive and railroad fields are far from being separate and distinct but on the contrary have many interests in common, and greater cooperation between the two should result to the advantage of both."

Ever since becoming a member of the Society in 1910 Mr. Spicer has been keenly interested in the SAE as a whole and its standardization work in particular. Prior to his term as chairman of the Standards Committee (1934-1937) he had served as chairman of its Broaches Division (1912-1914), Spline Fittings Division (1918), Shaft Fittings Division (1919), and held membership on other of its divisions. He has also represented the SAE on the Standards Council of the American Standards Association and has taken an active part in the work of several Sectional Committees functioning under the ASA procedure.

Mr. Spicer was treasurer of the Society in 1931 and 1932, has been chairman of the Finance Committee, held membership on the Engineering Relations Committee and the Nominating Committee, and has participated in the work of the Truck, Bus and Railcar Activity Committee.

A speaker before many meetings of the Society and its Sections, Mr. Spicer has had numerous of his papers selected for publication in the SAE JOURNAL. He has also contributed articles to other technical magazines.

In 1935 Mr. Spicer was presented with an honorary Doctor of Science degree by Alfred University, which he had attended before entering Cornell.

Retiring President Harry T. Woolson and Ralph R. Teetor, who was president of the Society in 1936, will serve on the 1938 Council.

David Beecroft will serve his sixth continuous term as SAE treasurer during 1938.

Photo by Blank & Stoller

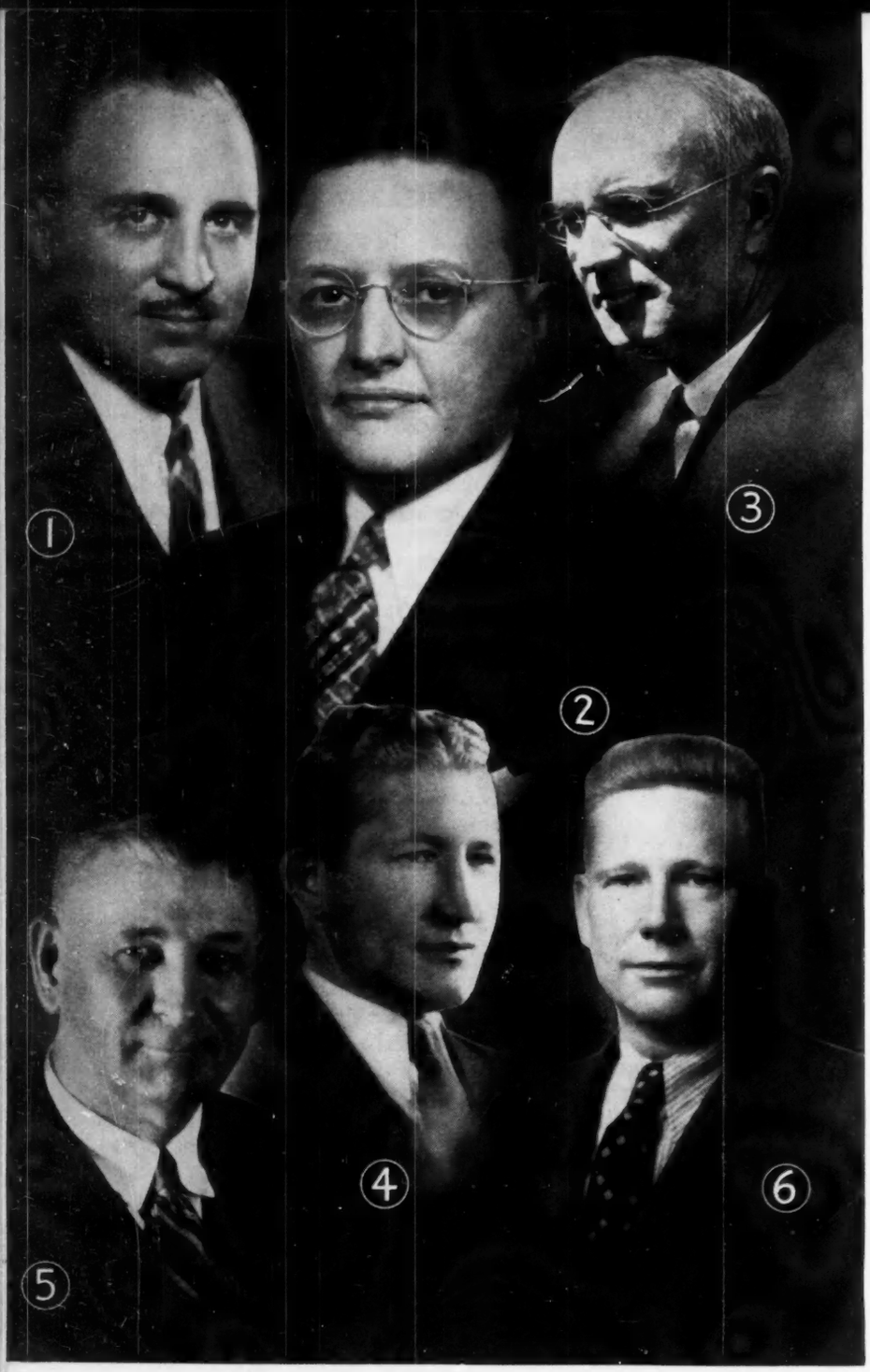
Photo by Lee F. Redman

Treasurer Beecroft

Past-President Teetor

Past-President Woolson

Vice-Presidents



1. CARL BEHN, who takes office as 1938 vice-president representing the Diesel Engine Engineering Activity, is with the Superior Engine Division of The National Supply Co. as assistant to the vice-president. He entered the automotive industry in 1912 with The Carstarphen Electric Co. of Denver, a dealer of automobiles and electric cars. From 1914 to 1917 he was with L. R. Bach & Co., another automotive concern in Denver. From 1917 to 1919 he was in the Army here and overseas. In 1920 he became owner of the Battery Specialty Co. of Chicago which he operated for three years before joining the Robert Bosch Magneto Co. as sales engineer, and later manager of its Detroit office. He continued with that company after it became known as the United American Bosch Corp., and specialized in the application of Bosch fuel injection equipment and the development of Diesel engines. In 1936 he became sales manager of the Philadelphia plant of the Superior Engine Division of The National Supply Co. and retains that position as well as assistant to the vice-president.

2. FRED L. FAULKNER, who served last year as chairman of the Chicago Section, will take office as 1938 vice-president representing the Transportation and Maintenance Activity. After receiving his B.S. in M.E. from Armour Institute in 1915, he entered the experimental engineering department of Western Electric Co. During 1917 and early 1918 he was safety engineer for Hartford Accident and Indemnity Co. and electrical engineer with Campbell, Wyant & Cannon. He entered the United States Army Air Service as master signal electrician in March of 1918 and later became transportation officer at Camp John Wise in Texas. After the War he was manager of the automotive department, Morris & Co., meat packers, and for several years was instructor in physics, and auto shop and electrical laboratory at the Lindblom Technical High School in Chicago. He also conducted lecture courses at the Knights of Columbus Ex-Service Men's Schools in Chicago. In 1926 he joined Armour & Co., and since then has been manager of their automotive department. After being affiliate representative of his company for several years, he became a member of the Society in 1935. He is a past-president of the Automotive Transportation Supervisors' Association; a member of the transportation committee of the Illinois Manufacturers Association and of the executive committee of the Motor Truck Owners Association. Since 1932 he has been active in the SAE, holding local Section offices and membership on many technical committees. For the past two years, in addition to serving on other SAE committees, he has been chairman of the Transportation Division of the Standards Committee. Mr. Faulkner has presented many papers before the Society and its Sections, a number of which have been published in the SAE JOURNAL.

3. FRANK S. SPRING, Hudson Motor Car Co. engineer, is 1938 vice-president representing the Passenger-Car Body Activity. After receiving his technical education abroad he was engaged in aircraft production work in this country during the War. He joined the Paige-Detroit Co. as engineer in 1920; was consulting engineer for the Standard Steel Car Co. during 1921; and from 1922 to 1924 was chief engineer with the Courier Motors Co. For the next seven years he was affiliated with the Walter M. Murphy Co., Pasadena, Calif.; starting as service manager in charge of all branches and advancing to general manager of the company. His connection with Hudson dates from 1931. Mr. Spring has been a member of the Society since 1923 and has served on the Passenger Car Activity Committee, and the Meetings Committee. He has also participated in Detroit Section activities. He was born in Emporia, Kansas.

4. H. E. SIMI, Truck, Bus and Railcar vice-president for 1938, is chief engineer of the Twin Coach Co. He attended the University of California, and, after receiving his A.B. degree in 1922, entered the employ of B. K. Parker Co. as assistant superintendent. Later that year he joined the engineering staff of Westinghouse Pacific Coast Brake Co., remaining with that company until June of 1925 when he took an engineering position with the Fageol Motors Co., in Oakland. Two years later he went to Kent, Ohio, to take his present position with Twin Coach. Mr. Simi was chairman of the Cleveland Section last year and since 1930 has been a member of the Truck, Bus and Railcar Activity Committee. He has also held membership on the Membership and Sections Committees, and last year was appointed to the Motorcoach and Motor-Truck Division of the Standards Committee.

5. E. N. SAWYER, consulting production engineer, Cleveland Tractor Co., heads the Production Activity as its vice-president for 1938. He started in the automotive industry back in 1899 as assistant superintendent of the Cleveland Electric Carriage Co. In 1905 he joined the Royal Tourist Co. as assistant superintendent. After two years in that capacity he joined the White Co. as division superintendent, and later was with the Continental Motor & Manufacturing Co. as superintendent. In 1916 he was made general superintendent of the Cleveland Tractor Co., remaining in that capacity until 1924 when he joined the Rollin Motor Co. as works manager. He rejoined the Cleveland Tractor Co. in 1926 as works manager and was made consulting production engineer in 1930. Mr. Sawyer became a member of the Society in 1918. He has served on the Production Division of the Standards Committee since 1926; as its chairman in 1927 and from 1933 to 1935. His membership on the Production Activity Committee

Representing SAE Activities, 1938

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dates from 1929. In 1936 and 1937 he was an SAE representative on the American Standards Association Sectional Committee for Standards for Small Tools and Machine Tool Elements. Mr. Sawyer was second vice-president of the Society representing Tractor Engineering in 1929.

6. Frank W. Caldwell, engineering manager, Hamilton Standard Propellers, takes office as vice-president for 1938 representing the Aircraft Engineering Activity. One of the outstanding men in aviation, Mr. Caldwell was awarded the Collier Trophy of 1934 for his invention of a controllable-pitch propeller and the Albert Reed Award of 1935 for development and improvement of controllable-and constant-speed propellers. During the investigation of the destruction of the Airship Hindenburg last year, Mr. Caldwell was one of the American experts called upon to take part. A graduate of Massachusetts Institute of Technology, he received early training with Curtiss. From 1917 to 1927, Mr. Caldwell was in the Air Service, United States Army, holding various executive engineering capacities. He was made chief of the propeller branch in 1920. In 1928 he established an office as consulting engineer, relinquishing his practice the following year to become chief engineer of the Standard Steel Propeller Corp.; and in 1931 of the Hamilton Standard Propeller Corp. Joining the SAE in 1917, Mr. Caldwell has served on the Publication, House and Aircraft Activity Committees.

7. Ralph N. DuBois, experimental engineer, Aviation Manufacturing Corp., will represent the Aircraft-Engine Activity as vice-president. After receiving his B.S.E. degree from the University of Michigan in 1922 he started with the Bureau of Standards in Washington as assistant mechanical engineer. Here he was engaged in research on aviation engines, being promoted to associate engineer in 1926. The following year he joined the A.C. Spark Plug Co. as research engineer. From A.C. he entered the Continental Aircraft Engine Co. as chief experimental engineer becoming assistant chief engineer in 1933. He took his present position with Aviation Manufacturing Corp. in 1934. Mr. DuBois joined the Society in 1925. He has served as secretary of the Washington Section, vice-chairman of the Detroit Section representing aeronautics, Detroit Section representative on the Meetings Committee, a member of the Aircraft-Engine Activity Committee and of the Fuels and Lubricants Activity Committee.

8. B. E. Sibley, who takes office as vice-president representing the Fuels and Lubricants Activity, is chief technologist of the Continental Oil Co., with headquarters at Ponca City, Okla. For the past two years the SAE National Regional Fuels and Lubricants Meeting held in the Mid-Continent has been under his direction. He started in the automotive business as a mechanic in an Asbury Park, N. J., garage in 1902. Several years later he moved to Denver and soon was in charge of vehicles owned by the State of Colorado. He joined the Continental Oil Co. in 1912 as an automotive engineer. His technical education in chemical and gas engine engineering came through extension courses, and he became a member of the Society in 1921. Mr. Sibley has been active on a number of SAE technical committees since 1929; last year serving on the Fuels and Lubricants Activity Committee, the Crankcase Oil Oiliness Research Committee, the Crankcase Oil Stability Committee and the Lubricants Division of the Standards Committee. He also represented the Fuels and Lubricants Activity on the Membership Committee.

9. Clyde R. Paton, who heads the Passenger Car Activity as its 1938 vice-president, is chief engineer of Packard Motor Car Co. He has been a member of the SAE since 1923. Starting in 1932 he has held continuous membership on the Passenger Car Activity Committee and the Research Committee. He was chairman of the Detroit Section in 1935 and the following year represented the Section on the Sections Committee. Mr. Paton was born in Almont, Mich., and one of his first ventures into the automotive business was to manage the Almont Garage from 1910 to 1915. For the next three years he was manager of the Paton Electric Service Co. During the War he served in the Air Service and, after he was mustered out, attended the University of Michigan as student assistant in mechanical engineering. From 1923 until 1925 he was with the National Advisory Committee for Aeronautics at Langley Field. During the next five years he was with Studebaker as laboratory engineer. In 1930 he joined Packard as experimental engineer, advancing to his present position in 1932.

10. C. E. Frudden, chief engineer of Allis-Chalmers Manufacturing Co., Milwaukee, is the vice-president of the Tractor and Industrial Power Equipment Engineering Activity for 1938. Identified with the Tractor Industry since 1910, he has held executive engineering posts with the Hart-Parr Co., the Parrett Tractor Co. and the Buda Co. He joined Allis-Chalmers in 1929 as engineer in the tractor division, advancing to chief engineer of that division in 1930. His membership in the Society dates from 1917. He has taken an active part in the standards work of the Society since 1923 and has held membership on the committees of the Tractor and Industrial Power Equipment, Fuels and Lubricants, and Diesel Engine Activities. He has also been treasurer, vice-chairman and chairman of the Milwaukee Section, holding the latter office in 1935. Mr. Frudden received his B.M.E. from Iowa State College in 1909. He also attended Columbia University.

1938 SAE Councilors

1. WALTER C. KEYS, mechanical product engineer, U. S. Rubber Products, Inc., will serve his second year as Councilor in 1938. He was previously a Council member in 1932 and 1937. He had his early automotive experience (1905-1912) with Buick Motor Co., U. S. Motor Co., Cadillac Motor Car Co., Chalmers Motor Co., and the Church-Field Motor Co. In 1913 he rejoined Cadillac as assistant chassis engineer. In 1917 he affiliated with the Perfection Spring Co. as mechanical engineer. During 1918 to 1927 Mr. Keys had executive engineering posts with the Standard Parts Co., the Eaton Axle Co., and the Gabriel Sales and Service Co. He joined the United States Rubber Co. in 1927 as chief engineer, mechanical automotive department. Mr. Keys, a member of the SAE since 1915, has been active on numerous divisions of the Standards Committee since 1917. In 1934 and 1935 he was chairman of the Life Membership Committee, and has held membership on many other general and technical committees. He received his B.S.E.E. from the University of Michigan.

2. JOHN L. STEWART, who serves his second year as Councilor, has been general manager of the Canadian Automobile Chamber of Commerce since 1931. Before that he was, for 15 years, manager of the automotive division of the Maclean Publishing Co. Mr. Stewart became a member of the Society in 1932 and the following year served as vice-chairman of the Canadian Section. He was elected chairman of the Section in 1934. In that year he was also a member of the Membership Committee and for the past four years he has been active on the Lubricants Division of the Standards Committee. Last year he was appointed a Canadian member of the Overseas Relations Committee. Mr. Stewart was born in Detroit, but moved to Canada at an early age. He was educated at the Queen Victoria School and Hamilton College.

3. A. T. COLWELL, who continues on the SAE Council during 1938, is vice-president in charge of engineering, Thompson Products, Inc. A graduate from the United States Military Academy at West Point, class of 1918, his education continued at the Engineer School, U. S. Army, at Fort Humphreys, Va., from which he received his C.E. degree in 1920. Promoted to first lieutenant, he continued in the Army for two years. He then resigned to join the Steel Products Co., which later became the Thompson Products Co. After a period during which he was in charge of sales and engineering in that company's Michigan territory, Mr. Colwell was appointed chief engineer in 1930. In that year he became a member of SAE. He was advanced to director of engineering in 1934 and vice-president in 1937. He served as chairman of the SAE Cleveland Section in 1936. Mr. Colwell has contributed to the work of the Production Activity Committee, the Tractor and Industrial Power Equipment Activity, the Sections Committee, and the Iron and Steel Division and the Parts and Fittings Division of the Standards Committee.

4. W. J. DAVIDSON, elected to membership on the Council for 1938 and 1939, has been chairman of the SAE Engineering Relations Committee since its organization two years ago. Long affiliated with the General Motors Corp. in important technical positions, he has recently taken office as general sales manager of General Motors' new Diesel activity. Mr. Davidson was born in Montreal, Canada, and was graduated from McGill with the degree of Bachelor of Science in Mechanical Engineering. He joined the engineering department of Cadillac Motor Car Co. in 1914 and since then, with the exception of the period of his World War service, has been almost continually with General Motors. Mr. Davidson served with the Motor Transport Corps in France and was discharged with the rank of captain in 1919. He was awarded the Cross of the Legion of Honor by France in 1934 in recognition of his war service and of friendly co-operation with French engineers since the War. Mr. Davidson became a member of the SAE in 1926; having been affiliated previously with the Society from 1915 to the date of his enlistment. Since 1929 he has been active on technical and general committees of the Society. In 1934 he was chairman of the Constitution Committee and for the past two years has served as SAE representative on committees of the American Standards Association and as a member of the Highways Research Committee.

5. LAWRENCE J. GRUNDER will serve on the Council during the next two years. He is automotive engineer for the Richfield Oil Corp., Los Angeles, with which he has been affiliated since 1932. A graduate of the California Institute of Technology, class of 1929, he continued his studies at Pennsylvania State College as a fellow in lubrication research, the following year. Before entering college and during summer vacations he added to his engineering education by working in the fuels section of the City of Los Angeles Engineering Department testing laboratories, as towerman for the Southern California Edison Co., inspector for the Regan Forge & Engine Co., and draftsman with Burns & Lewis, mechanical engineers. After his year at Penn State he was automotive research engineer with Hughes Development Co., Los Angeles, before joining Richfield. He became a member of the Society in 1927 and soon was active in the Southern California Section. In 1934 he was the Section's representative on the Meetings Committee. The next year he was elected vice-chairman and was appointed the Section's representative on the Sections Committee. In 1937 he was elected Southern California Section Chairman, continued as its representative on the Sections Committee and was a member of the Society's House and Fuels and Lubricants Committees.

6. BURTON J. LEMON, tire engineer, U. S. Rubber Products, Inc., will serve on the Council for the next two years. After graduating from Cornell University with an A.B. degree in 1908 he was an instructor in analytical chemistry at the University until 1915. During this period he received his Ph.D. in chemical engineering. From Cornell he joined the U. S. Rubber Co. as assistant to director, general laboratories. Since then, with the exception of the War period, when he was commissioned as captain, Motor Transport, United States Army, he has been with U. S. Rubber. For a number of years he was field engineer, tire development division, in Detroit. He was transferred to New York as technical representative, tire division, U. S. Tire Co., in 1933, and took his present position the following year. His membership in the Society dates from 1923. He served as chairman of the Detroit Section in 1929, has been a member of the General Research Committee since 1926 and chairman of the Front-Wheel Alignment Committee since 1931. He has also participated in the work of other standards, research and general committees and is the author of numerous technical papers presented before the Society.

"Best-to-Come" Theme Dominates All Annual Meeting Sessions

(*Continued from page 20*)

being considered to eliminate this danger. A discussion of design and operating details of the system took up the major part of Mr. Davies' presentation.

An instrument, termed the "Flightray," that coordinates and concentrates six degrees of information necessary for instrument flying on one dial was described by Dr. Zand. Instrument flying should be simpler and safer with this device, he pointed out, for the pilot can focus his vision on one dial instead of trying to scatter it all over the instrument board. A number of successful landings already have been made with the instrument, he reported.

Dr. Zand's instrument corresponds with a device now being developed at the Bureau, contributed I. R. Metcalfe, Bureau of Air Commerce, except that our design is based on giving the pilot the illusion of seeing three lights on the ground right over the nose of the airplane. To supplement Mr. Metcalfe's discussion, Mr. Geisse explained the geometry and operation of the three-light dial system.

Completely Automatic Control Visioned

"Now that automatic landing is an accomplished fact, it is well within the realm of reason to visualize an airplane taking off from an airdrome, flying to its destination, and landing, the whole performance being completely automatic," speculated Captain Holloman reporting the results of two years' development work by the Materiel Division, U. S. Army Air Corps. The work was directed specifically toward making instrument landing automatic, he said.

"Such control would relieve flight crews of all duties except to observe instruments and to see that the automatic equipment is functioning properly," he continued.

As proof that automatic landing is an accomplished fact today, he told of two entirely automatic landings that were made within an hour at the Materiel Division last summer under adverse wind and air conditions.

The work reported was undertaken, he explained, because pilots had expressed, in no uncertain terms, a need for simplification of a growing number of controls.

Beside control of direction, automatic landing involves other factors, such as control of altitude, engine control, "slow-cruise" control, "let-down" control, and further control after landing, Captain Holloman pointed out, explaining how each type of control is accomplished automatically.

Chairman Weick launched the discussion by inquiring and finding out what was done to compensate for the effect of the wind gradient in increasing the vertical speed when hitting the ground on landing.

A plea for justification of the blind-landing activity throughout the country and the many systems under development was voiced by Mr. Metcalfe, who explained that the airlines were asking for just one system. With a different system for private planes than that used by the airlines, it would be impossible for a private plane to make a blind landing in an airline airport with its accompanying danger and disrupting effect on schedules, and vice versa, he pointed out.

Research at the Bureau on instrument flying is a "triple-headed monster," he continued, consisting of the three-light control system discussed previously, the straight-line glide path where you get the plane in landing position and keep it there, and an investigation of infra-red ray control methods.

Instead of simplifying instruments, Mr. Geisse suggested that the airplane designer himself might simplify instrument flying so that trim remains constant in spite of throttle conditions. "Experience making blind landings with the tricycle landing gear has been most successful," Captain Holloman contributed.

After a spirited three-cornered debate among Mr. Weick, Mr. Metcalfe, and Mr. Geisse, the majority finally held that, using a properly designed two-control plane, automatic blind landings would be simplified.

A suggestion by W. N. Gerhardt, of Wayne University, that the complexity of instruments could be eliminated by complicating the design of the aircraft, such as a rotating-wing machine, was vetoed by Mr. Geisse who stated that, in the present stage of the rotating-wing machine's development, he prefers the conventional type.

"What is the expression for an automatic machine that operates automatic pilots?" was the riddle posed by Dr. Zand to end the session.

A brief business session of Aircraft Activity was conducted by 1938 Vice-President Frank W. Caldwell.

Truck, Bus and Railcar Session

Tuesday Morning **S. Johnson, Jr., chairman**

The Outlook Toward Legal Performance Requirements **– PROF. J. T. THOMPSON, Johns Hopkins School of Engineering.**

AFTER a short business meeting presided over by 1938 Vice-President H. E. Simi, the technical session of the Truck, Bus & Railcar Activity was devoted entirely to Dr. Thompson's paper and the discussion it created.

Handling Slow Moving Traffic

The phrase "20 m.p.h. up a 4 per cent grade," used so often in conversation about performance requirements for trucks and buses, should be restated "*X* m.p.h. up a *Y* per cent grade" until some later date when a rational basis for legal performance requirements can be established, Dr. Thompson declared.

He sees four ways of overcoming the problem of slow moving traffic on hills that interferes with the tempo of traffic and makes for danger, namely: reduce gradients; separate fast and slow moving traffic; hold powerplants at present level and reduce legal loads; retain present load restrictions and increase engine power. Obviously, he said, none of these will be adopted to the exclusion of the others. "An intelligent approach demands that economics and safety of highway transport be studied as it is influenced by the application to the problem of the various combinations of these possibilities."

Dr. Thompson then outlined a performance study which is being carried out by the Bureau of Public Roads in harmony with the Interstate Commerce Commission and the automotive industry through such bodies as the Truck Subcommittee of the Automobile Manufacturers Association of which D. C. Fenner is chairman. The first step has been to study current hill-climbing practice on a uniform 6 per cent grade located on U. S. 40, near Baltimore. The hill was located 4.5 miles from a State road-pit scale, and its length of 2000 ft. was sufficient to decelerate practically all trucks to a constant climbing speed, he reported.

After describing the instruments used for recording speed of trucks at eleven points on the hill, Dr. Thompson prefaced his discussion of the data with the statement that they are in

no way conclusive as they are based upon a handful of observations which were more or less incidental to the development of method.

Among the interesting results it was found that of the vehicles studied only 50 per cent negotiated the grade at a speed of 11 m.p.h. or greater, and that 95 per cent traveled at a speed of less than 20 m.p.h. It was also shown that heavy trucks and truck-trailers appear to have more difficulty than lighter trucks. Likewise it was found that heavier trucks reach the crawl speed at an earlier point on the hill than do lighter trucks.

Speaking of special tests made with low-mileage trucks it was found that in practically every case the gross load which actually pulled the vehicle down to its crawl speed was far below that computed by formula, being on the average about two-thirds of the formula value. In this work the engine speed corresponding to the recorded road speed was computed by the formula: $\text{r.p.m.} = \frac{168 \times R \times S}{r}$. The published engine torque corresponding to the known engine speed was then inserted in the formula: $GVW = \frac{T \times 12 \times E \times R}{r\left(\frac{G}{100} + f\right)}$ in which the coefficient of rolling resistance, f, was taken as 30 lb. per gross ton.

Looking ahead, Dr. Thompson explained that extension of this work is already planned and arranged for. It will be carried forward on three fronts: (1) a large amount of further data on hill climbing practice through the agency of several of the State highway planning surveys; (2) it has been arranged through the motor transport division of the Quartermaster Corps of the Army to use its dynamometer laboratory at Camp Holabird for a study of special vehicles; and (3) attention is being given to the availability or development of devices to be used in enforcement of performance regulations when they are finally promulgated.

The dynamometer studies are to parallel the hill tests and will be used to determine the best possible performance of new vehicles; how ability is affected as age and mileage increase; and to verify some of the performance formulae or, in the absence of a verification, possibly to establish empirical coefficients which will pull them in line with observed facts.

When the discussion period came around Merrill C. Horine, Mack Manufacturing Corp., remarked that it is refreshing to see a legislative project attacked in such a scientific manner. We have little to fear, he said, in regulation based upon such factual studies, adding that the result of the project should be of value to the industry.

Regarding the discrepancies between observed and formula rating, Mr. Horine believes that it is partly due to the use of advertised torque rating in the formula, which, he said, shows peak torque reached under laboratory conditions as the result of a dynamometer test and is not reproducible on the road.

This belief was seconded by L. Ray Buckendale, Timken-Detroit Axle Co., who also noted that there is quite a departure between the torque of a new truck and one that has seen service.

Written discussion prepared by W. F. Childs, State Road Commission, Maryland, was read by Chairman Johnson. In it Mr. Childs suggests the roads be given consideration. Delay to the normal flow of traffic by slow-moving vehicles is not confined to grades, he said, but also to horizontal curvatures when sufficient sight distance is not provided. It is his opinion that cutting off of knolls of summits and improving sight distance on horizontal curves may result in the elimination of these obstructions to free-moving traffic by the rehabilitation of as little as 10 per cent of the mileage. Where this cannot be done because of the terrain he suggests widening the highway at points where traffic is retarded, providing an extra lane at the extreme right for slow-moving vehicles.

Capt. O. A. Axelson sees the work outlined by Dr. Thompson as of considerable value, but feels that the driver is apt to be a factor in the tests due to the varying ability of drivers to operate trucks.

Another point of view was given by S. G. Tilden who suggested that instead of using a test hill for this work an accelerometer be used. If the minimum pounds drawbar-pull per ton could be established it would be possible to conduct a test anywhere, he said.

Fred C. Patton, Los Angeles Railway Corp., wanted to know if the plan is to have all vehicles tested or just trucks and buses, reminding the audience that there are still hay wagons, horse driven, that would fail almost any tests for performance. There are some antique passenger cars in this category too, he added.

Others contributing to the discussion included John M. Orr, Equitable Auto Co., Carl J. Bock, General Motors Truck Corp., and H. O. Mathews, Public Utilities Engineering and Service Corp.

Transportation and Maintenance Sessions

Monday Morning — **J. M. Orr, chairman**

Economic Maintenance of a Concentrated Fleet of Large Trucks – **G. W. LAURIE, Atlantic Refining Co.**

Economic Maintenance of a Concentrated Fleet of Mixed Vehicles – **S. B. SHAW, Pacific Gas & Electric Co.**

Economic Maintenance of a Scattered Fleet – **H. O. MATHEWS, Public Utility Engineering & Service Corp.**

Monday Afternoon — **F. K. Glynn, chairman**

What Fleet Operators Should Know About Tires – **J. E. HALE, Firestone Tire & Rubber Co.**

SMALL-TOWN dealers were scored for doing poor fleet service work and traveling inspector-mechanics were blamed and defended in Transportation and Maintenance Sessions which included as well expositions of ways to increase fleet operating and maintenance efficiencies and a brief evaluation of tire retreading and recapping as an incident in broad discussion of specialized modern tires.

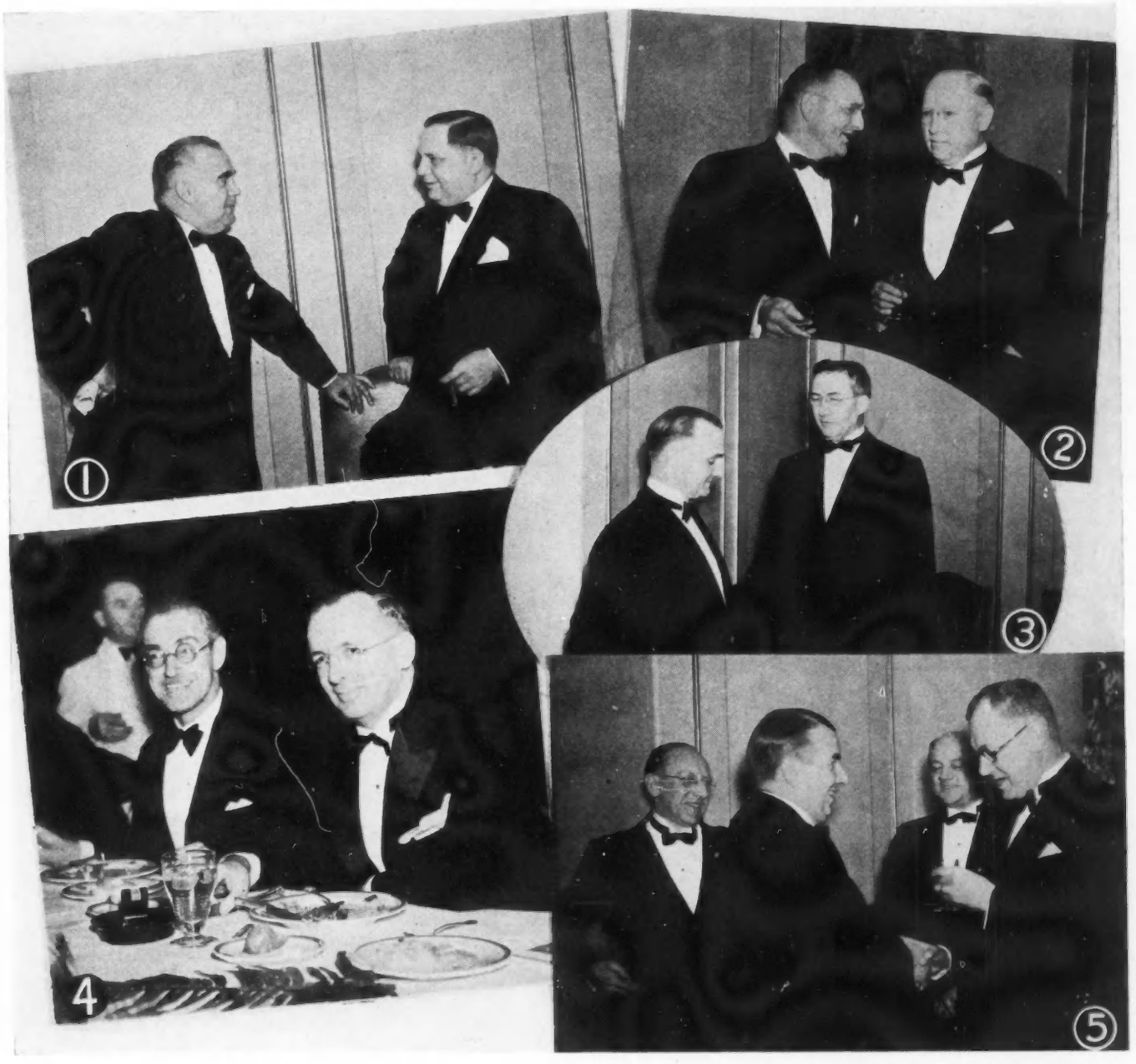
Retreading, if properly done, will deliver 70 to 80 per cent of the mileage obtained from the original tires and will cost about half as much as a new tire, Mr. Hale said in his paper. It was Mr. Mathews who strongly bewailed the fact that the best dealer service stations are in big towns where fleet-owning companies usually maintained their own garages and that the service work of the small-town dealer often leaves much to be desired.

Presiding at the first session, Chairman Orr called first upon Mr. Laurie to present his paper.

Guesswork Brings Poor Maintenance

Stating that guesswork is not consistent with economic maintenance, Mr. Laurie emphasized the importance of detailed records in determining the contributing factors making for either high or low maintenance costs in a concentrated fleet of large trucks. He outlined the system used by his company in recording the history of each truck and showed

Aviation, Army and Automobile Leaders Are Dinner Guests



1. Fred M. Zeder, vice-chairman of the board, Chrysler, and George W. Mason, Nash-Kelvinator president.

2. R. H. Fleet, president, Consolidated Aircraft Corp., and George W. Lewis, director, aeronautical research, National Advisory Committee for Aeronautics.

3. Maj.-Gen. Oscar Westover, chief, U. S. Army Air Corps, and Glenn L. Martin, president, Glenn L. Martin Co.

4. SAE Past-President William B. Stout and C. L. McCuen, general manager, Oldsmobile.

5. F. F. Kishline, chief engineer, Graham; John A. C. Warner, SAE secretary and general manager; Rowland Campbell, chairman of the board, Reo; W. J. Davidson, Diesel division, General Motors.

how it reveals both premature failures and periods of normal-life failures.

Mr. Laurie defines premature failures as "failures of parts due to manufacturers' errors in design, selection of materials, or the use of faulty parts that would have been rejected if uncovered at the time of inspection before assembly." When these failures are brought to the attention of the manufacturer they are, in most instances, admitted and corrective measures are applied, he said, adding:

"A closer servicing contact between the manufacturer and the fleet operator should be encouraged with the purpose of the manufacturer divulging to the operator failures uncovered by the manufacturer. In many instances the manufacturer is cognizant of the existing weakness as evidenced by the fact that corrective measures are immediately available."

For replacements due to normal operating life failures, he pointed out, the basis of scheduling for service and preventive maintenance is determined by operating data and records.

Mr. Laurie likewise explained the value of operating records as the basis of selecting new trucks, considering such factors as expense per mile of the old unit and estimated expense of the new, miles per year covered, physical condition of old

unit, overhaul estimate, trade-in value of old unit, net purchase price and net return on net investment.

Before closing his paper, he particularly stressed the importance of lubrication in vehicle maintenance and suggested that the man doing this work have enough mechanical ability to permit him to observe those things that might cause failures if neglected – and either correct or call attention to them.

Systematic Inspection Needed

Mr. Shaw was unable to come from San Francisco to present his paper so Capt. O. A. Axelson took his place at the rostrum.

Stating that his experience has been with a group of fleets ranging in size from 20 to 375 vehicles, Mr. Shaw said that the most concentrated of these is in San Francisco where 375 trucks operate almost entirely within an area of 50 square miles.

He pointed out the necessity of balancing fixed charges (interest, depreciation, taxes and insurance), against depreciation, noting that if annual mileage is low the vehicle with higher maintenance cost per mile, but with lower fixed charges, may be the cheaper of the two in the long run. He told of the practice of his company to "de-rate" vehicles as they become older. Under more favorable conditions, he said, such vehicles continue in service with a minimum of expense.

Likewise Mr. Shaw remarked on the importance of standardizing vehicles, supplies and practices; good working conditions in the shop; and the keeping of concise but adequate records.

He believes that systematic inspection and preventive maintenance is the key to the elimination of road failures and to low-cost operation. He recommends inspection at every 2000 miles, but not less frequently than every eight weeks. He favors scheduling of inspection on the time basis because it permits the handling of shop work at a more uniform rate.

He contends that the best mechanic available should be assigned to inspection work and that each mechanic should be assigned a group of vehicles, as in this way he gets familiar with them. This plan promotes responsibility for good and thorough work, Mr. Shaw declared.

Service Work Criticized

Any traveling inspector-mechanic whose duties are to inspect and service vehicles in a scattered fleet would have shivered in his boots if he had heard Mr. Mathews' paper; and some dealers would have hung their heads in shame had they listened in. The speaker argues that the traveling inspector-mechanic costs too much, quoting figures to the effect that he has found that each inspection runs in the neighborhood of $3.

Mr. Mathews also bewails the fact that the best dealer's service stations are in cities and towns where company garages are maintained and that many of those in smaller towns are such that you would question the service received.

Calling attention to the work of a large car and truck manufacturer in developing a preventive maintenance plan which involves the dealers' service, Mr. Mathews hails it as a step in the right direction. The present trouble is that this service is only available in the larger cities, and in small towns dealers are not familiar with the plan, have no interest in it, and are not prepared to carry it out.

There are similar plans worked out by other manufacturers and operators, varying as to whether or not some work is done in the operator's own shop, but no matter what the plan, it is necessary for the manufacturers to educate the small town dealers who are involved in fleet maintenance. The fleet operator must cooperate in this educational program and the dealer must be paid a fair amount for the work performed, Mr. Mathews stated. He also added that the driver must assume the responsibility for regularity of the inspections and that no deviation from a standard inspection form should be allowed.

He noted that the cost of inspection under the plan mentioned above would average about $2, which is considerably less than when a traveling inspector does the job.

Jack North, of Commonwealth and Southern, the first discusser, sees preventive maintenance as a joint job of manufacturer, operator, and dealer; thinks that as manufacturers detect failures in their vehicles they should advise operators; and added that manufacturers' maintenance manuals should be made more available to fleet operators. He thinks that most preventive maintenance schedules are too complicated and outlined a simplified system that his company finds satisfactory. Mr. North stressed the importance of shop layout and proper tools, stating that his company has developed standard lists of tools and equipment for shops servicing groups of cars, according to the number of cars serviced.

Fred L. Faulkner, Armour & Co., came to the defense of the traveling mechanic. Although he finds that the cost per inspection tallies with that found by Mr. Mathews, the rate of pay per hour corresponds closely with that of dealer-shop labor and the job is better done.

Agreeing with Mr. Mathews that traveling inspector-mechanics are unsatisfactory, H. R. Grigsby, Oklahoma Gas & Electric Co., also has found that most small town dealers' work is poor. He believes that drivers as well as dealers must be educated to see that an inspection plan is carried out in dealers' shops. Capt. Axelson has found that maintenance costs average higher in groups of trucks serviced by dealers as compared to those taken care of by traveling inspector-mechanics. The cost per inspection under the latter system averages more, but the work is better done, he stated, adding that the dealer has no personal feeling for the car whereas the inspector-mechanic has. Leo Huff, Pure Oil Co., also spoke in defense of the traveling inspector-mechanic, as did Mr. Laurie. Austin Wolf stated his belief that a unit replacement plan will play an important part in fleet operation of the future and believes that this will help solve the small-town dealer problem.

Oscar M. Brede, General Motors Truck & Coach, reviewed the great strides made in preventive maintenance. He believes that simplification is now in order as "mechanics hate paper work." He also spoke of efforts on the part of manufacturers to get maintenance facts written so that they are understandable to mechanics. Mr. Brede also spoke of the necessity of educating the dealer to cooperate with fleet operators on maintenance work. Mr. Mathews added to this by remarking that the dealer must be shown that continued maintenance means more profit than a new-vehicle sale with high trade-in and other incidental expenses.

From New Zealand, Z. C. Tatton, who represents The Texas Co. in that country, brought greetings from the engineers "down under." He stated that the United States and Canada furnish more than 50 per cent of the cars and trucks in use in New Zealand and Australia, adding that the "working vehicles" are mostly American. He praised the SAE JOURNAL as one of the most valued contacts with the outside world.

Tire Problems Complex

Tires were the main attraction at the afternoon Session and after being introduced by Chairman Glynn, Mr. Hale gave what was later termed "an encyclopedia of information."

The tire business becomes more and more complex each year, Mr. Hale declared, adding:

"As a consequence the fleet operator, to get the most out of

Technical Subjects Taboo as Dinner Gets Underway

1. James M. Crawford, George Spatta
2. H. W. Alden, T. V. Buckwalter
3. G. E. Platzer, E. R. Maurer, D. T. Fraser
4. R. E. Morrison, D. E. Austin
5. O. R. Skelton, E. W. Austin
6. W. C. Keys, Louis Schwitzer

tires, has to specialize in his selection of tire equipment and must, too, understand the problems which develop in the use of tires in connection with his particular type of operation." With the aid of well-selected slides he then described each type of tire and its applications.

Among those listed were passenger car tires, which he said, have been perfected to the point where they may be expected to deliver from 16,000 to 20,000 miles of non-skid life and still be free from body-ply failures. Truck and bus tires, both balloon and high-pressure, average from 35,000 to 50,000 miles before they are worn out. It is his belief that the use of high-pressure tires should be discontinued in favor of the lower pressure balloon sizes on trucks because of reduced maintenance, protection to fragile goods, faster average speeds, driver comfort, less tendency to sink in soft soils, they run cooler, better equalization of load on duals, longer treadwear,

less destructive to pavements, better traction non-skid and better all around service.

He spoke of commercial-delivery tires, mud and snow tires, stop and start tires, rock-resisting tires, earth-moving tires and road-grader tires. In connection with tires in the earth-moving group he showed by means of moving-picture the actual torture that these tires are subjected to. In this work and in some other service where tires are subjected to extra heavy work they seldom wear out through normal use but are cut and chewed to pieces. Mr. Hale reported that his company has found large singles better than duals in rock operations.

He told of the development of rayon cords for tires intended for use under heat conditions. This, he said, is because rayon does not lose tensile strength to the extent that cotton does when heated. He believes that rayon is now too expensive to justify the increased cost over tires made of cotton.

After listing the principal types of tire failures, Mr. Hale advised the operators of ways and means of preventing or postponing them; warning particularly against the evils of overloading, high-speed driving, under-and over-inflation and curb scuffing.

Retreading, if properly done, will deliver 70 to 80 per cent of the mileage obtained from the original tread and costs about half as much as a new tire, he said. The speaker stressed the necessity of retreading only good casings and having the work done by a responsible retreader. He also suggests favoring the retread by placing it in easy service.

Before closing his paper Mr. Hale spoke briefly on tire repairing and regrooving.

Dr. B. J. Lemon, U. S. Rubber Products, Inc., was the first to discuss Mr. Hale's paper. On the subject of premature tire failures in operations where supervision is not so well established, he took as an example the Federal control of large fleets quickly assembled for CCC work. Tire mileage on CCC vehicles in the early stages of the work was exceptionally low, he said, and quoted from an analysis of 4000 tires discarded by CCC camps throughout the United States to show that in some regions as few as 20 per cent were worn out from normal wear. The other 80 per cent of the tires, he said, failed prematurely, due, as near as could be diagnosed, to shortage of experienced drivers, rough theatre of operation, lack of inflation equipment and lack of experienced maintenance and service personnel. He noted also that the survey disclosed little differences in service rendered by high-pressure and balloon types of tires.

Dr. Lemon also emphasized that every special-purpose tire offered by the tire industry is economical only if confined as far as practicable to its special field. In this connection he reported that mud-snow tires had been put in service in many localities of CCC operation that didn't warrant their use and that they proved uneconomical.

Answering questions by T. C. Smith, American Telephone & Telegraph Co., Mr. Hale emphasized the need of having extremely prominent ribs on front tires of road scrapers to maintain steering qualities, and said that in a fleet operating at speeds of less than 50 m.p.h. tires with rayon cords would show little advantage.

R. D. Evans of Goodyear expressed his belief that rayon will come down in price as use expands and that its use in tires has many possibilities.

Austin Wolf feels that tire mileage on some makes of cars would increase if frames and front-wheel suspensions were made more rigid. He also sees the human element as a factor in tire wear, particularly in the passenger-car field. Mr. Wolf asked if it would not be possible to construct some instrument capable of measuring tread wear for use in developing purchase specifications.

In answer to this question Mr. Hale said that it is impossible to compute the number of scientific man-hours of effort devoted in vainly trying to develop an abrasive machine to do this job. So far as he knows there is no such machine in sight.

Mr. Faulkner told of satisfactory experience with recapping of tires rather than full retreading. This, he said, keeps the tire in better balance. He has also found that the salvage percentage is better if tires are removed from vehicles before they are too badly worn. He has no recapping done if the tire has had more than two minor repairs. Mr. Faulkner only uses recapped tires on vehicles which do not operate at more than 45 m.p.h., and makes no front-wheel applications.

Speaking of balance, Mr. Hale said that so far as he knows no effort is made to balance retreaded tires – the retreader just hopes they are in balance. He agrees with Mr. Faulkner that recapping is satisfactory if the casing is removed from the vehicle at the proper time and carefully checked against defects.

Following the discussion 1938 Vice-President Faulkner presided at a brief Business Session.

Aircraft-Engine Sessions

Tuesday Morning **A. L. Beall, chairman**

Analysis of the Accessory Drive Problem on Aircraft Engines **– R. P. LANSING, Eclipse Aviation Corp.**

Analysis of Improvements in Aviation Spark Plugs **– T. TOGNOLA and A. W. DeCHARD, Scintilla Magneto Co., Inc.**

Tuesday Afternoon **William Littlewood, chairman**

Engine Installation and Related Problems in Large Aircraft **– I. L. SHOGRAN, Douglas Aircraft Co.**

Accessory Knock Suppressors **– L. B. KIMBALL, Fuel Development Corp.**

DEFINITE progress on four critical fronts of aircraft-engine development was reported in papers presented at the Aircraft-Engines Sessions. One paper suggested several ways to relieve aircraft engines of part of their increasing accessory load; another brought the spark-plug erosion problem nearer solution with new designs and revealing tests; a third discussed engine installation problems of large transports that are complicated by an increasing number of engines; and the last gave an insight into the design and operation of a system that combines the functions of octane regulator and de-icer.

Increasing Accessories Burden Engine

Accessories that are driven by the airplane engine have been increasing at such incredible speed that they present a serious engineering problem, warned Mr. Lansing whose paper was read by C. I. MacNeil, also of the Eclipse Aviation Corp. With superchargers, manifold-pressure regulators, wing de-icers, vacuum pumps, oil pumps for automatic pilots and landing gear, the governor drive for the constant-speed propeller, and an alternator drive for remote instrument operation all being added to the engine load since 1935, the casual observer might well wonder where the power for the propeller was to be found, he pointed out.

To solve the problem and eliminate the present "Christmas-tree" appearance of the engine with its maze of accessories with their associated pipe lines, cables, operating rods and other appurtenances between the fire wall and the engine, Mr. Lansing suggested that the accessories be divided into two groups. The first group, consisting of accessories intimately connected with the functioning of the engine, must continue to be located on the engine, Mr. Lansing pointed out. The

second group, comprised of accessories pertaining to the operation of the airplane as a whole, Mr. Lansing recommended driving by means of a flexible shaft driven by the airplane engine; a hydraulic motor driven by a hydraulic pump on the engine; an exhaust-driven turbine; an electric motor driven by a large generator on the engine; or an auxiliary gasoline engine, all after mounting the accessories on a separate accessory drive unit or gear box.

Where ground operation of the gear box and its accessories is desirable or essential for operation of the radio, cabin heating, lighting, and so on, power must be supplied by an external source, such as an auxiliary gasoline powerplant, Mr. Lansing explained. This is one of the important reasons why the largest ships of the future will carry auxiliary engines for accessories of this second group, he concluded.

A suggestion, advanced by J. H. Geisse, Bureau of Air Commerce, that consideration be given to an auxiliary steam engine taking waste heat from the exhaust, for driving accessories met with opposition from R. K. Hazen, Allison Engineering Co., who contended that, with both engine superchargers and pressure-cabin turbines driven by the exhaust in future planes, there would be no power left in the exhaust for such an engine. Mr. Hazen also stressed the necessity of having the auxiliary powerplant of the same high standard of reliability as is the main engine. Weight and fuel consumption will be slightly higher with an auxiliary gasoline engine, Mr. MacNeil conceded to several discussers.

"The paper still leaves the engine designer up a tree as he is not told to provide for driving the accessories in any definite way," claimed A. T. Gregory, Ranger Engineering Corp., in a plea for more specific recommendations.

Spark-Plug Erosion Attacked

After hearing that the spark-plug has been a contributing factor in retarding the development of experimental high-output aircraft engines, we made investigations of their requirements which showed that rapid electrode erosion was probably the worst offender in keeping the spark-plug behind the procession, reported Mr. DeChard who read the paper written jointly by himself and Mr. Tognola.

The accumulation of lead deposits and their subsequent fusion on the core nose led to serious preignition characteristics, he continued, and heat and pressure waves within the cylinder have a tendency to lead to disintegration of the insulation, resulting in ultimate breakdown.

Describing a spark-plug design made with these conditions in mind, Mr. DeChard continued: "It appeared logical that the ground electrode should be of substantial dimensions and should incorporate desirable properties to withstand the action of the heat and gases within the cylinder and to obtain longer life. It also appeared logical that a ground electrode of the full-baffle type with slots incorporated would help to prevent rapid accumulations up to the core nose."

Mr. DeChard then swung into the principal part of the paper in which he discussed the results of erosion tests on four different electrode materials; voltage tests to determine the voltage required to break down various air-gap settings with various core and shell electrode patterns; finned versus unfinned plugs; and bomb-testing.

Discussion took the form of a barrage of questions laid down by practically every one at the session, most of which queries Mr. Tognola found time to answer.

"Is the effect of temperature on the sparking voltage characteristics so pronounced that some of the conclusions reached in a cold bomb test could not be applied to engine running conditions," was one of five questions asked by Hector Rabezzana, AC Spark Plug Division, General Motors Corp., in written discussion read by Neil MacCoull, The Texas Co. What we want to find out in bomb-testing is the voltage which, when applied to the plug, will detect any plug not up to standard, was Mr. Tognola's reply.

The spark-plug gap used and emission quality have a negligible effect on fuel consumption, Mr. Tognola told E. O. Petzold, Standard Oil Development Co. A plug that uses radio-active material uses less voltage, hence the magneto is affected, he explained, adding that this was the only effect of the gap on fuel consumption. His answer was supported by Chairman Beall who said that, once you get the spark across the gap, the gap and quality have no effect on fuel consumption except at very lean mixtures.

Questions concerning the necessity and operation of the dual ignition system were started by Mr. Geisse, who inquired whether the pilot is forewarned if one plug in a cylinder, with no thermocouple attached, goes out. William Littlewood, American Airlines, Inc., replied that roughness and loss of power were symptoms and that there was plenty of power left with one magneto out of operation. If you are operating on two plugs and one goes out, you can survive and continue to operate by increasing the mixture strength, contributed Chairman Beall. Even though spark-plugs and ignition systems could be made 100 per cent reliable, explained Mr. Tognola to another discusser, two plugs would be required to get the full power out of the cylinder.

"Every spark that jumps over the gap is different," Mr. Tognola pointed out to Mr. MacCoull, concurring with his suggestion that the spark-plug may have considerable to do with the fact that cyclic variation is much more pronounced with Otto-cycle than with Diesel-cycle engines. Additional turbulence does not seem to reduce cyclic variation beyond a certain point, Mr. MacCoull replied to a discusser advancing this suggestion.

Others joining in the discussion included Kenneth Campbell, Wright Aeronautical Corp.; J. P. Stewart, Socony-Vacuum Oil Co.; R. N. DuBois, Aviation Mfg. Corp.; E. S. Twining, Champion Spark Plug Co.; and Rudolf Mangold and Louis Beeh of United American Bosch Corp.

Four Engines Complicate Installation

"The aggregate experience of five of the country's leading airlines as well as that of the manufacturer is represented in the Douglas DC-4," announced Mr. Shogran. And this paper considers problems of engine installation that arose during the development of this 60,000-lb., four-engined transport, he continued. Carrying 42 passengers, this ship is approximately twice the size of any regularly operated transport land plane in the United States today, he pointed out.

"We have incorporated into this plane four independent fuel systems, one for each of the engines," Mr. Shogran explained. "Each engine has a 100-gal. tank for take-off fuel and a 300-gal. tank for cruising fuel," he went on, telling how fuel can be piped from one tank to another during flight and how all four tanks can be fueled at the rate of 100 gal. per min. at the landing fields.

The cockpit is arranged for a pilot, co-pilot, and another man who may be a radio operator-navigator or an engine operator, he continued, explaining that the third man sits between and a little to the rear of the pilot and co-pilot, and is in reach of all the controls with all instruments in sight.

"The Air Corps has only recently been using some of the external-type regulating valves to which Mr. Shogran refers," said Weldon Worth, U. S. Army Air Corps in prepared discussion, "and, when congealing has been experienced with the integral-type valve in flight and laboratory tests at the Materiel Division, it has been possible to overcome the trouble by increasing the pressure available to cause circulation through the core."

The same system of fuel, oil, and other control as was employed on the DC-4 would not do for larger ships with six or eight engines because of greatly increased complication, answered Mr. Shogran to the first of several questions raised by Mr. Beall. However, he continued, we are now working on a new system of control for still larger ships. To another query he stated that the DC-4 is as large a ship as should be flown without a flight engineer. Auxiliary engines are tested for the Department of Commerce in a mockup nacelle with everything just as it is in the plane, was his reply to Mr. Beall's third question.

"A new era in vibration elimination began when a device was perfected for measuring the frequencies and amplitudes of vibrations on an airplane while in flight," announced Dr. Stephen J. Zand, Sperry Gyroscope Co., Inc., answering the request of Walter R. Jones, United Air Lines Transport Corp., for information on the status of the vibration problem. This apparatus was described in a paper presented by Dr. Draper of Massachusetts Institute of Technology at the 1937 SAE National Aeronautic Meeting in Washington, D. C. This apparatus is a great stride forward, Mr. Zand pointed out, because we must first measure the vibrations – know what they are – before we can eliminate them.

Asked about the provisions for dumping gasoline on the DC-4 by W. I. Stieglitz, Barkley-Grow Aircraft Corp., Mr. Shogran revealed that his company was now experimenting with a swing spout that will swing down and allow the gasoline to flow out rapidly when necessary to dump gasoline.

Combined Knock Suppressor and De-Icer

Although the "Anilol" system was started as an octane regulator, it is now difficult to say which phase of the system is more important, the de-icing feature or the octane regulation, remarked L. B. Kimball. Anilol, he explained, is an antiknock fluid consisting of aniline and a mixture of various alcohols together with corrosion-resisting inhibitors.

Consisting principally of a discussion of the different systems and valves employed to supply the fluid to the fuel systems in different types of planes, Mr. Kimball's paper concluded with a summary of the uses of the system: (1) to raise the octane number of the fuel as the throttle is opened beyond the cruising range, (2) to reduce cylinder-head temperatures and permit greater throttle opening without detonation, (3) to continue to raise the octane value of the fuel so that emergency maneuvers during take-off can be accomplished with safety, (4) to assure take-off without formation of carbureter ice without the use of carbureter heat, (5) to assure the immediate removal of carbureter ice which may be picked up in coming in for a landing, and (6) to assure high-altitude operation in icing conditions without loss of power or use of heat.

Both the aniline and the alcohol constituents of Anilol contribute to its de-icing ability, the aniline acting as a carrier of the globules of alcohol, Mr. Kimball maintained in answer to a question put by H. K. Cummings, National Bureau of Standards.

Anilol is effective but a minimum quantity must be used before there is any effect, contended Mr. Beall. Higher powers require a bigger percentage of the fluid to get the same effect as with lower power and, therefore, adjustments must be made as the power changes, he continued, reporting poor results with the distributing system.

Use of an old system with manual control instead of the accurate control hooked up with the manifold pressure now available, plus a separator action in the blower section observed in the tests discussed by Mr. Beall, probably account for these poor results, Mr. Kimball explained.

Discussing a method of mixing alcohol mentioned by Mr. Geisse which prevents the alcohol from separating out with increase in moisture content, Mr. Kimball contended that any system should be able to de-ice at any position, not just at the butterfly valve. The Anilol system also de-ices at the scoop and jets, he concluded.

A brief business session of the Aircraft-Engine Activity was conducted by 1938 Vice-President Ralph N. DuBois.

Production Session

Wednesday Evening **W. B. Hurley, chairman**

An Appraisal of Current Progress in Automotive Manufacturing **– JOSEPH GESCHELIN, Detroit Technical Editor, *Automotive Industries*.**

The Use of Self-Tapping Screws in Mechanical and Structural Assemblies **– RALPH UPSON, Consulting Engineer.**

FEATURING a survey of manufacturing progress with its philosophical and sociological effects plus the complete story of the self-tapping screw, the Production Session brought fresh ideas to suit the taste of both the practical- and the visionary-minded.

Production Progress Interpreted

"The most fundamentally new process in use today is that of surface-broaching," said Mr. Geschelin in his review of progress in automotive manufacturing. Since its adoption several years ago for broaching engine main bearings, the process has spread amazingly into all plants for a variety of operations, he pointed out. Other processes reviewed included climb-milling and climb-hobbing, single-point boring, welding, grinding, stamping, and finishing with synthetic enamels.

Dividing machine tools into three general types – single-purpose, unit-type, and universal-type – Mr. Geschelin reported that the unit-type of machine tool has been steadily gaining in importance in both mass-production and job-lot plants because of its flexibility. Its versatility lies in the adaptability of a given machine to a variety of similar products or to complete change-over on a seasonal basis, simply by altering some of the basic heads or fixtures, he explained. By this means the burden on each machine is lowered and the period of amortization is lengthened as compared with a single-purpose machine, he added, thus costs are lowered.

Reflecting and supplementing the theme of the Flint Production Meeting, Mr. Geschelin named the emphasis on proper coordination between production and engineering as the "first and foremost lesson that he had learned in the past few years of constant contact with most of the major plants of the industry. In most successful organizations," he reported, "the production department sits in with the design engineers, frequently before the design has reached the drafting board, and follows it through until it is released for production. This new practice not only is the key to many reductions in cost," Mr. Geschelin concluded, "but it also has contributed tremendously toward obtaining a smooth uninterrupted production flow."

In the first of three prepared discussions of Mr. Geschelin's paper, F. T. Ellis, Cadillac Motor Car Co., stressed the "tremendous progress that has been made in the past few years in heat-treating equipment. In fact," Mr. Ellis pointed out, "this development has been so rapid that heat-treating equipment has usually been put out of date within two or three years with more economical designs."

"A thoughtful analysis of our achievements, as surveyed in Mr. Geschelin's paper, should be most helpful in mapping

our course for the future," contributed Fred C. Pyper, Buick Motor Co. "In order to take full advantage of our experience, it is necessary to weigh our accomplishments modestly and our failures honestly," he concluded.

Tying in the ideas of Mr. Geschelin's paper with the school of economic thought that believes in constant improvement in the efficiency of industry, lower costs, and wider distribution of goods, Tell Berna, National Machine Tool Builders Association, concluded: "The ultimate significance, therefore, of these improved manufacturing methods to an industrial nation like our own is the fact that, in the last resolution, they serve to make possible a higher standard of living for the employee."

Self-Tapping Feature Demonstrated

The only difference between an ordinary screw and a self-tapping screw, explained Mr. Upson, is that the screw threads of the self-tapping screw must be substantially harder than the material which they are to displace. The thing that made modern self-tapping screws for metal feasible was the process of case-hardening, apparently first tried to harden the threads about 20 years ago, he continued.

Summarizing advantages of self-tapping screws Mr. Upson pointed out that they save the separate operation of tapping the female threads; the self-tapping feature insures a tight fit; and they permit working from one side of the work alone.

Before getting into the exhaustive technical treatise presented in his paper, Mr. Upson demonstrated the tightening and loosening torque characteristics of self-tapping screws by self-tapping a screw into a nut on a manually operated testing machine provided with a gage that indicated the torque.

Answering a question as to the size limitations of self-tapping screws asked by H. W. Klas, of Packard Motor Car Co., Mr. Upson stated that they can be used in any size that can be inserted. Nos. 8 or 10 screws, he explained, are as large as can be put in by hand, and the 5/16-in. size requires too much torque for hand-driving, the auto companies using power-drivers for this size. Supplementing Mr. Upson's information, E. McClelland, Shake-Proof Lock Washer Co., reported that his company was making self-tapping screws in sizes up to ¾ in., and that they were of standard pitch with slotted round heads.

With the point brought up by another discusser that it may be simpler and more economical to use regular screws with tapped holes made by highly developed tapping equipment for small sheet-metal assemblies put together on a bench, Mr. Upson was in agreement. However, he added, future developments and volume production may soon lower the cost of self-tapping screws so that they can compete in this field.

In a study of relative costs of self-tapping screws versus rivets for bodies on a recent bus job, Mr. Upson recalled in answer to Chairman Hurley's question, we found that the

SAE *Coming* EVENTS

Baltimore—Feb. 3

Engineers Club; meeting 8:00 P.M. Mr. William H. Beck, automotive and industrial engineer, Sherwood Bros., Inc., will talk on Highlights of S.A.E. Annual Meeting. In a separate address he will also discuss the subject of Color Research.

Buffalo—Feb. 8

Hotel Statler; dinner 6:30 P.M.

Canadian—Feb. 16

Royal York Hotel, Toronto, Ont.; dinner 7:00 P.M. Recent Developments in Piston Rings – Ballard Yates, chief metallurgist, McQuay Norris Mfg. Co.

Chicago—Feb. 8

Medinah Club; dinner 6:30 P.M. Newer Sources of Motor Fuels – Dr. Gustav Egloff, director of research, Universal Oil Products Co.

Cleveland—Feb. 14

Cleveland Club; dinner 6:30 P.M.

High-Speed, Two-Cycle Diesel Engine – John Dickson, assistant chief engineer, Diesel Engine Division, General Motors Corp.

Dayton—No meeting

Detroit—Feb. 7 and 21

Feb. 7 – Hotel Statler, meeting 8:00 P.M. The Automatic Transmission – Harold T. Youngren, chief engineer, Olds Motor Works.

Feb. 21 – Hotel Statler; dinner 6:30 P.M. Development of 1938 Graham-Paige – W. H. Neely; Problems of Swinging a New Body into Production – Frank Coates.

Indiana—Feb. 10

Antlers Hotel, Indianapolis; dinner 6:30 P.M. Wear Reduction of Piston Rings and Cylinders – Macy O. Teetor, in charge of research engineering, Perfect Circle Co.

Kansas City—March 3

Afternoon and evening sessions.

National Passenger Car Meeting

March 28-30, 1938 Detroit
Hotel Statler

National Aeronautic Meeting

March 10-11, 1938 Washington, D. C.
Mayflower Hotel

Summer Meeting

June 12-17, 1938
White Sulphur Springs, W. Va.
The Greenbrier

Metropolitan—Feb. 8

The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P.M. Fuel Injection – H. C. Edwards, Fuel Injection Equipment Division, Timken Roller Bearing Co.

Milwaukee—Feb. 4

Milwaukee Athletic Club; dinner 6:30 P.M. Modern Gasoline Carburetion – Frank C. Mock, vice-president, Bendix Products Corp., assisted by E. O. Wirth, chief engineer auto. carb., Bendix Products Corp.; A. H. Winkler, Jr., experimental engineer, Bendix Products Corp., and W. E. Gebhardt.

New England—Feb. 8

Walker Memorial, M. I. T., Cambridge, Mass.; dinner 6:30 P.M. Subject – Car Manufacturing.

Northern California—Feb. 5

Fairmont Hotel, Terrace Ballroom, San Francisco; dinner 6:30 P.M. Annual Dinner Dance and Valentine Party.

Northwest—Feb. 4

Mayflower Hotel; dinner 6:30 P.M. Motor Bearings – R. A. Watson, Pacific Division, Federal Mogul Corp.

Oregon—Feb. 11

Imperial Hotel, Portland; dinner 6:30 P.M. Subject – Rapid Calculation with Slide Rule Estimating. A report of the S.A.E. Annual Meeting will also be presented by J. Verne Savage, superintendent, City of Portland Municipal Shops.

Philadelphia—Feb. 9

Engineers Club; dinner 6:30 P.M. Private Flying – John H. Geisse, chief, Aeronautic Development Section, Bureau of Air Commerce.

Pittsburgh—Feb. 4

Webster Hall; dinner 6:30 P.M. Annual Ladies' Night. Sketch-talk – Women vs. Men Drivers – Hazel and Murray Fahnestock. Dancing.

Southern California—Feb. 11

Hollywood Athletic Club, Los Angeles; dinner 6:30 P.M. Six-Wheel Construction – A. K. Brumbaugh, West Coast representative, Timken-Detroit Axle Co.; Automatic Transmissions in Buses – C. B. Lindsay.

Southern New England—Feb. 2

Bond Hotel, Hartford, Conn.; dinner 6:30 P.M. Educating the Engineer – Harvey N. Davis, president, Stevens Institute, and president A.S.M.E.

Syracuse—No meeting

Washington—Feb. 8

Cosmos Club, Washington, D. C.; dinner 6:30 P.M.

cost of joining with self-tapping screws was less than half that of riveting. The fact that work has to be done on only one side of the joint with the screws as compared with both sides for the rivets not only accounted for much of the difference in cost, but it also simplified the entire design of the vehicles, Mr. Upson pointed out.

A brief business session of the Production Activity was conducted by 1938 Vice-President E. N. Sawyer.

Diesel-Engine Sessions

Thursday Morning — **T. B. Rendel, chairman**

The Diesel as a High Output Engine for Aircraft – **E. G. WHITNEY and H. H. FOSTER, National Advisory Committee for Aeronautics.**

Diesel-Engine Deposits as Influenced by Fuel Types and Operating Conditions – **J. R. MacGREGOR and W. V. HANLEY, Standard Oil Co. of Calif.**

Friday Morning — **A. W. Pope, Jr., chairman**

Diesel Supercharging – Its Effect on Engine-Design Features and Performance – **RUSSELL PYLES, Clark Brothers Co.**

General Consideration of the Supercharging of Diesel Engines – **HARTE COOKE, American Locomotive Co.**

THE Diesel Sessions on Thursday and Friday brought considerable discussion regarding the respective merits of two-stroke-cycle and four-stroke-cycle Diesel engines, particularly for aircraft; the comparative fire hazard of gasoline and Diesel fuel; and of the turbo-type supercharger vs. the direct-drive type.

Diesel Advantages for Aircraft

Chairman Rendel opened the Thursday session by calling on Mr. Whitney to present his and Mr. Foster's paper.

Speaking of the outstanding success of the Junkers engine development in Germany despite the strides made by the gasoline engine with improved cooling and better fuels, Mr. Whitney declared that it cannot fail to attract the attention of even the most skeptical concerning the merits of Diesel engines for aviation. "Especially is this true," he said, "when well qualified authorities predict for the 100-octane gasoline engine in the next five years fuel consumption no better than 0.38 lb. per b.hp-hr. and specific engine weights in a 2000-hp. unit, no less than 1 lb. per hp., whereas the Junkers Jumo engines are operating today at specific fuel consumptions as low as 0.36; and a 2000-hp. engine development is in progress to weigh less than 1 lb. per hp."

Mr. Whitney then discussed results obtained at the National Advisory Committee for Aeronautics laboratory which he summarized as follows:

1. The four-stroke-cycle Diesel engine with the present technique of combustion control can, through the use of higher boost pressures and with maximum cylinder pressure not over 1400 lb. per sq. in., provide a maximum power for take-off equal to that obtainable from present gasoline engines using 100-octane fuel to maximum power advantage.

2. The same Diesel engine can attain lower specific fuel consumptions than the lowest obtainable from the gasoline engine using 100-octane fuel to maximum economy advantage.

3. Because the antiknock value of the fuel does not limit the performance of the Diesel engine, it offers the possibility of using very high cylinder pressures to the advantage of power and fuel economy, if engine materials and design technique are developed to use them.

4. The use of after-coolers with the highly boosted Diesel engine offers substantial increases in mean effective pressures obtainable for a given specific fuel consumption.

5. The altitude performance of the Diesel engine will be fully equal to that of the gasoline engine, although the higher boost required of the Diesel may require more stages in the blower.

6. The two-stroke-cycle Diesel engine offers the possibility of greater power per unit of size and weight than a similar four-stroke-cycle Diesel engine at the expense of increased fuel consumption.

7. Successful development of the Diesel engine requires research in improving combustion, improving materials and design technique to accommodate higher cylinder pressure, and improvement of blowers and after-coolers.

The second paper, which was read by Mr. MacGregor, discussed Diesel engine deposits as influenced by fuel types and operating conditions. In it the authors outlined the methods they used to study the combustion processes.

The conclusions drawn from this work indicated that in those Diesel engines which are critical to fuel deposition, a decrease in operating temperature and load, or an increase in altitude, increases the quantity of deposit formed. In these engines, they said, increasing the average volatility or the cetane number of the fuel decreases the deposit.

The paper also revealed that an approximation of the deposition tendencies of distillate fuels in engines which form appreciable amounts of deposits may be obtained from the Conradson Carbon of the 10 per cent bottoms remaining after 90 per cent has been distilled off in the conventional A.S.T.M. gas oil distillation. For fuels of this type, the authors stated, the usual Conradson Carbon test fails to correlate with engine deposits. For residual-type fuels the Conradson Carbon test provides a convenient means of predicting engine deposition characteristics while the Conradson Carbon of the A.S.T.M. distillation 10 per cent bottoms is valueless, they said.

The authors also noted that in those engines in which fuel deposition is slight no consistent differences between fuels and no correlation with physical properties of the fuels are apparent.

These tests covering a wide variety of engine designs, fuels and operating conditions, have demonstrated that the engine designer has greater control over the quantity of deposits formed in the engine than have the fuel refiner or engine operator, the authors stated. They showed this in test results presented in which the ratio of deposits were 20 to 1 between extremes in engine design, 10 to 1 in operating conditions and 3 to 1 between extremes in distillate fuels.

When Chairman Rendel opened the meeting for discussion the response indicated the intense interest created by the two papers.

On the subject of safety in case of fire A. L. Beall, Wright Aeronautical Corp., stated that when higher output Diesel engines are developed they will require a uniform fuel well freed from gums that it may be as volatile as gasoline. On the other hand, Mr. Whitney considers that gasoline is much more dangerous than Diesel fuel is or will be and that there will be a time when we will no more fly in a plane filled with gasoline than an airship filled with hydrogen.

Mr. Whitney's statement that Diesels do not knock was challenged by several discussers, one of whom, M. G. Fiedler, William Sellers & Co., said that Diesels do nothing but knock.

Speaking of the two-stroke-cycle Diesel, Prof. P. H. Schweitzer, Pennsylvania State College, said that it is usually spoken of as having exhaust valves, while he believes that the ideal Diesel would be without valves. He believes that of the three uniflow scavenging methods, with valves, opposed pistons, sleeve-type, one of the latter two should give better performance than that predicted by Mr. Whitney.

Stating his belief that a four-stroke-cycle Diesel would be more reliable at high speeds, Hans Fischer, Lanova Corp., stated that one of the difficulties is to get heat out of the pistons of a two-stroke-cycle engine, while in the four-stroke-cycle engine the pistons get a breathing spell during which they can cool.

E. S. Hall, Round Engine Patents, presented written discussion in which he spoke of the round or barrel-type engine with pistons parallel to the shaft as being particularly excellent as a two-stroke Diesel engine for aircraft.

Also participating in vigorous discussion were F. L. Garton, Shell Petroleum Corp.; D. P. Barnard, Standard Oil Co., Ind.; and J. B. Fisher, Waukesha Motor Co.

Opening the second Diesel Session Friday morning, Chairman Pope introduced Carl Behn, 1938 vice-president representing the Diesel Activity, who conducted a short business meeting.

Brake mean effective pressure of a Diesel engine may be increased 50 per cent by supercharging without the introduction of factors requiring major design changes, was the conclusion stated by Mr. Pyles in summing up his report of an investigation of Diesel supercharging upon design features.

He found, however, that certain features demand consideration. Among the most important are: lowering of compression ratio; complete scavenging of the clearance volume; locating the blower drive so as to have a minimum effect on frequency; and making provision for the effect of increased gas pressure on the connecting-rod bearing.

Mr. Pyles believes that the simplicity of supercharging with its resulting reduction in engine weight promises a wider future application. Furthermore, he said, it appears economically sound to include supercharging as an essential part of the initial engine design as the cost per horsepower is correspondingly reduced.

With the statement that superchargers first came into use to supply air to engines operating at considerable altitude so that they would have sea-level intake air, and be able to develop full output, Mr. Cooke opened his paper. The logical outcome was to supercharge at sea level and increase output, he added.

In general, he remarked, the output of a Diesel engine is limited in larger sizes by the heat conditions that parts of the combustion chamber can stand. However, he continued, in the smaller sizes, on account of the high ratio of cooling surface to the volume of the combustion chamber, the output is limited by the mean effective pressure that can be developed.

He pointed out that the maximum temperature depends upon the ratio of fuel burned to the air present in the cylinder; the air performing two functions, to furnish the oxygen for combustion and to act as a dilutent to limit the maximum temperature. This means, he continued, that with a given engine, if the mean effective pressure is increased beyond a certain limit, the maximum temperature will increase proportionately and the heat transfer, being as the fourth power of the temperature difference, will soon reach the point where its effect on the walls of the combustion chamber will cause excessive maintenance. In view of the above, he said, it can be seen that if more air is provided in the cylinder by introducing it at a pressure above atmospheric, more fuel can be burned without increasing the maximum temperature because the ratio of air and fuel will be the same.

Mr. Cooke also noted that the rise in pressure from the compression pressure to the maximum, is less with a supercharged engine. With a smaller engine, he explained, the cooling effect of supercharging, which reduces the maximum temperature, is not so important as the improvement in combustion due to the higher density.

Of the various arrangements to provide air for supercharging, Mr. Cooke spoke of the reciprocating pump, the displacement blower, and the turbo-type blower. The method which has been used more than all others, he said, is a turbo blower, the turbine being driven by exhaust gases from the Diesel engine, such as is done by Messrs. Rateau of France, and the Buchi Syndicate of Switzerland. He noted particularly that to facilitate the scavenging of the cylinders at low supercharging pressures, Mr. Buchi divides the exhaust pipe so that the pressure due to the exhaust of one cylinder does not interfere with the scavenging of the cylinder next to it.

With the high-speed two-cycle Diesel, practically no supercharging can be obtained, he stated. This is on account of the short time period available for getting air into the cylinder. Mr. Cooke noted, however, that an arrangement of a gas turbine-driven blower in series with the regular scavenging blower has been used to increase the mechanical efficiency of the engine. This is beneficial, he said, but the saving possible hardly justifies the extra equipment required.

Referring to tests made by the N.A.C.A., Charles S. Moore, of that group, in discussion read by Mr. Whitney, said they have shown that at a given compression ratio supercharging decreases the ignition lag and consequently the rate of pressure rise. These decreases, he explained, are owing to both increased temperature and density of air charge. Continuing, he noted that supercharging engines of 5-in. bore at speeds of 1500-2500 r.p.m. acts to soften or even eliminate combustion shock. It is possible, Mr. Moore declared, that with the decreased shock of supercharged operation, somewhat higher cylinder pressures may be used for the same degree of engine wear. Also, he said, with the shortening of ignition lag caused by supercharging, fuels of slightly inferior ignition quality may be used.

Professor Schweitzer and some other discussers questioned Mr. Cooke's statement that supercharging is more in order for large than small engines. In answer Mr. Cooke said that we don't really know the limitations or possibilities of supercharging, and suggests that the only way we can find out is to try and see how far we can go.

Two SAE
National Meetings:

Aeronautic

Washington *March 10 & 11*

Passenger Car

Detroit *March 28-30*

Fuels and Lubricants Sessions

Thursday Afternoon — **C. H. Baxley, chairman**

The Reduction of Wear of Piston Rings and Cylinders – **MACY O. TEETOR, Perfect Circle Co.**

What Is an E.P. Product? – **J. A. MOLLER, Pure Oil Co.**

Effect of Oil Characteristics on Wear in Aviation Engines – **DR. O. C. BRIDGEMAN and M. L. LEIDIG, National Bureau of Standards.**

Friday Afternoon — **A. G. Marshall, chairman**

C.F.R. Motor Survey – **J. B. MACAULEY, JR., chairman, Motor Survey Section.**

C.F.R. 1937 Road Knock Tests – **T. A. BOYD, chairman, Road Test Planning Group.**

Effect of Test Conditions on Fuel Rating, C.F.R. Report – **A. E. BECKER, chairman, Laboratory Procedure Group.**

Carburetion, Manifolding and Fuel Antiknock Value – **EARL BARTHOLOMEW, HAROLD CHALK, and BENJAMIN BREWSTER, Ethyl Gasoline Corp.**

Friday Evening — **J. B. Macauley, Jr., chairman**

High-Speed Motion Pictures of Engine Flames Correlated with Pressure Cards – **GERALD M. RASSWEILER and LLOYD WITHROW, Research Division, General Motors Corp.**

OPENING to a record-breaking attendance of 800 with a sensational new method of paper presentation that may well revolutionize present practice, the Fuels and Lubricants Sessions started off with an enthusiasm that was maintained throughout all three meetings.

Test results on a wear-reducing surface treatment for piston-rings; a comparison of wear characteristics of six extreme-pressure lubricants; and the suggested possibility of custom-made aviation lubricants to give the wear-resisting and other qualities of the lubricant desired to suit the conditions of each specific application, indicated a decided emphasis on wear reduction in the first session. The three C.F.R. reports that were presented in the next session, dealing with the annual Motor Survey, road knock tests, and laboratory knock tests, were followed by a comprehensive study of the fuel-distribution problem. New high-speed motion pictures of engine combustion, and their interpretation in terms of pressure changes produced within the engine, provided a spectacular conclusion.

Novel Presentation a Feature

"Surfacing a piston-ring material by means of a treatment that changed the structure of the surface for a depth of approximately 0.0005 in. produced a surface that we found to be ideal from a wear standpoint," reported Mr. Teetor, reading his paper in perfect synchronism with motion pictures that illustrated each point in a novel and dynamic way. Wear tests in operation, test samples, graphs, and micrographs of structure flashed on the screen in such perfect timing with his reading that many thought that they were seeing and hearing a carefully prepared talking picture.

The structure of the surface layer so produced, Mr. Teetor continued, was extremely fine and granular but firmly rooted to the original remaining structure. Tests on the wear machine indicated that this surface structure resisted wear because it was not too tenacious to resist abrasion and, in abrading, broke down into a very fine polishing medium which polished the cylinder sample, the ring sample also acquiring a high polish, he pointed out. With respect to the scuffing resistance of rings surfaced by this process, called "Ferrox," Mr. Teetor reported that a sample that was run on a nitrided-steel cylinder did not scuff or cold-weld to the cylinder up to the load and speed capacity of the wear-test machine.

Typical E.P. Lubricants Compared

"It would appear that an extreme-pressure lubricant must have all the characteristics and properties which an ordinary lubricant has had to date – but to a greater degree," concluded Mr. Moller after presenting test results comparing and discussing six typical extreme-pressure lubricants.

"Furthermore," he continued, "it would seem that laboratory tests may be correlated to field data and may be reproduced among laboratories within a small degree of error."

Contending that commercial pressure is stifling research along extreme-pressure lines by restricting purchases to one or two types of lubricants, Mr. Moller closed with a plea for joint cooperation between suppliers and users so that problems will be solved before, rather than after, they become urgent commercially. Further, he added, if differences among lubricants arbitrarily tested without consideration for field performance are to be publicized, it should be borne in mind that differences also exist among the testing devices employed.

"A very close correlation" between Mr. Moller's results that showed excessively high wear rates in wear tests at pressures above a predetermined load, with those published in a paper on extreme-pressure lubricants presented last September at the Chicago Sectional Regional Transportation Meeting of the SAE by himself and C. A. Crowley, was pointed out in written discussion by F. A. Faville, Faville-LeVally Corp.

"Our experience indicates that we can lubricate our hypoid axles successfully with a mild type of extreme-pressure lubricant," reported F. L. Faulkner, Armour & Co., explaining that all hypoid axles are serviced in the manufacturers' shops.

The SAE E.P. Lubricants Testing Machine was developed to indicate a new characteristic of relative resistance to scuff of E.P. lubricants, and it has done this job well, explained W. S. James, Studebaker Corp., in an effort to clear up any misunderstood belief that the SAE machine was a standard or standardized machine. Discussing Studebaker's experience testing extreme-pressure lubricants, Mr. James stated that, in working in cooperation with the bearing and axle manufacturers, no excessive wear or difficulty due to scuffing had been found with any extreme-pressure lubricant tested for 10,000 miles in the field. However, he concluded, our results on laboratory machines have varied widely, and correlation between laboratory and axle tests has been poor.

Ten billion passenger-car miles of service tests a year show that wear of hypoid axles using commercial extreme-pressure lubricants is not a serious problem, claimed G. H. Freyermuth, Standard Oil Co. of N. J., again pointing out the difference in results with different testing machines.

Sees Tailor-Made Aircraft Lubricants

"It is possible to picture a state of knowledge of lubrication in relation to wear in which lubricants can be built up for any given set of operating conditions or any metal combinations by compounding with a highly stable mineral oil small percentages of the appropriate compounding material," Dr. Bridgeman speculated after reviewing the growing number of variables that complicate aviation lubrication. In addition to compounding for wear control, he continued, it may also be necessary to compound for reduction in ring-sticking, for high oiliness, for extreme-pressure characteristics, and for protection against corrosion and rusting, depending upon the characteristics desired.

Test apparatus, he went on, must be designed specifically for each application, simulating service conditions as closely

as possible, and the tests must be made on the particular metal combination involved.

"Wear is the removal of material from one or both of two surfaces moving relative to one another during their relative motion," was the universal definition quoted by Dr. Bridgeman in defining the problem discussed.

"Furthermore, wear is not an inherent property, and no wear value can be assigned to any metal which will have significance except in relation to the specific test conditions under which the wear value was obtained," contended Dr. Bridgeman in his concluding summary.

Octane Needs of 1937 Cars

Octane requirements of 6 of the 25 1937 cars tested, corrected to 29 in. hg. barometric pressure, showed an average value of over 70 octane number with standard spark setting, announced Mr. Macauley, adding that spark advance was the principal cause of the spread encountered. A difference of 1000 ft. in altitude below 6000 ft. is equivalent to a change in requirement of about 3 octane numbers, he continued in a discussion of the results of altitude tests. In general, he went on, we found that vapor lock was most likely to occur on full-throttle acceleration after a stop of 5 min. following the 30-min. stabilization run, and the vapor-pressure limits of the 23 models tested ranged from 4.2 to 12.0 lb. per sq. in. when corrected to standard conditions.

In a plea for the cooperation of more motor-car manufacturers in the motor survey work, Mr. Macauley pointed out that a large proportion of the recent increase in specific engine output has been due to fuel progress and that future research will be repaid by further advances.

Road-Test Report

Reporting the road-test portion of the extensive efforts of the Cooperative Research Committee to get as precise a correlation as possible between the laboratory knock ratings of automobile fuels and their corresponding ratings in cars on the road, Mr. Boyd described the 19 fuels tested in both their summer and winter volatilities. Discussing the tabulation of car ratings and laboratory ratings, he cautioned:

"It should be recognized that these average road ratings which are recommended for correlation purposes are averages and, as such, do not apply specifically to any one make of car. The tabulation of ratings for each make of car clearly shows how wide the spread actually was among different makes of cars. "Furthermore," he continued, "the original data showed nearly the same spread in ratings among different cars of the same make."

Using statistical analysis methods to estimate the degree of reproducibility of Mr. Boyd's average ratings on various fuels, John M. Campbell, General Motors Corp., figured that, for preferred fuels, there was an even chance that they would vary by 0.2 octane number, and 1 chance in 10 that they would vary by 0.5 octane number. The element of chance enters strongly into these ratings, he pointed out, especially when only one or two cars of a particular make are tested when results may be accidental and inconclusive.

Laboratory Knock-Test Report

This report, presented by Dr. Becker, is published in full on pages 63-72, TRANSACTIONS SECTION, this issue of the SAE JOURNAL.

Poor Distribution Found

The large cross-sectional area of intake manifolds and the minimum amount of mixture heating in today's cars are diametrically opposed to good fuel distribution at low speed where knocking has become prevalent, contended Mr. Bartholomew, reading the paper prepared jointly by himself and two colleagues.

By sampling the mixture within each cylinder of an eight-cylinder car when it was accelerating at low speed, we found that the mixture ratio in each cylinder varied from 11.56:1 to 16.01:1, he reported. He then described the combination spark-plug and gas sampling valve, and other special apparatus used to obtain the samples.

It is to be hoped that a not-too-expensive means will be found for minimizing these variations, Mr. Bartholomew concluded, and that an effort will be made to correct present inequalities in the road performance of fuels of equal octane number arising because of the mixture-distribution problem.

"It would be very unwise to proceed with the adoption of a modified C.F.R. test until Mr. Bartholomew has had time to examine the manifold phenomena more thoroughly and to learn whether a practical correction for these phenomena can be applied to the laboratory test," opined L. E. Hebl, Shell Petroleum Corp.

Urging that "haste be made slowly" in attempting to tie in fuel volatility with road antiknock behavior, A. J. Blackwood, Standard Oil Development Co., reported that, according to tests conducted along similar lines to those described in Mr. Bartholomew's paper, the qualitative distribution factor may not be anywhere near as important as previously anticipated. We obtained our mixture ratios with an individual Orsat apparatus at each cylinder, and tests were made at constant speed, Mr. Blackwood stated, replying to questions put by Mr. Bartholomew and C. E. Cummings, Texas Co.

The difference in test conditions of constant-speed and acceleration may explain the difference in results reported by Mr. Blackwood and those of our paper, Mr. Bartholomew explained.

"We do not wish to leave the impression that the mixture-distribution problem is the one remaining variable in the knock-rating correlation problem," he concluded, "as we will be surprised if a 1938 model does not bob up soon."

Flame Pictures Interpreted

It is highly desirable to interpret the flame pictures in terms of pressure changes produced within the engine, pointed out Mr. Withrow, since the power output, knock, and roughness in engines appear to be related in some way to the rates of pressure rise and to the magnitudes of maximum pressure obtained. Considerable effort, therefore, has been made to obtain accurate pressure data from the engine cylinder during the photographing of the flame pictures, Mr. Withrow continued.

After showing typical knocking and non-knocking motion pictures of engine explosions taken with the same high-speed camera set-up that was described in the authors' paper at the 1936 SAE Summer Meeting, Mr. Withrow explained in detail the ingenious methods developed to measure these pressures.

The value of our work will consist largely in its interpretation for possible use in pressure indicator cards, Mr. Withrow concluded.

There are four possible sources of error in our method of determining the per cent of volume inflamed: the curvature of the flame front may not be perpendicular; the movement of the flame during the finite time that the exposure is made; the plaster casts may not be homogeneous; and there is some guesswork in definitely establishing the flame front, Mr. Withrow replied to R. M. Herron.

Asked by Neil MacCoull, Texas Co., what went on in the cylinder in the interval between ignition and the first visible flame, Mr. Withrow replied that there was a small flame there but, as yet, the camera has not been able to get a picture of it.

A brief business session of the Fuels and Lubricants Activity was conducted by B. E. Sibley, 1938 vice-president.

News of the Society

Effect of Weather Conditions on Radio Named Transport Pilots' Chief Concern

● No. California

The effect of weather conditions on radio and flight plans, the meteorologist's job, what the constant-speed propeller has done for aviation and the development of the ultra-safe low-cost plane for private use were topics at the Northern California Section's Dec. 14 meeting. Section Chairman A. H. LauFer presided and the speakers were introduced by Willis Campe of United Air Lines.

W. C. Ables, assistant superintendent of operations, Pacific Division, United Air Lines, led off the program by stating that in operation of modern airlines engineering progress has relieved operators almost entirely from concern regarding engine and structural failures. Thus, operation of the airplane as it is affected by various kinds of weather and disturbances which affect the operation of its radio are now of principal concern, he said. In regard to the latter, the old problem of static is still paramount. Investigational work has found that static can be subdivided into several kinds: those caused by rain, storm conditions, ice and snow. Work in conjunction with various universities and with a special flying laboratory, has permitted United Air Lines to develop a static arrester which affects some improvements, but, according to the author, is far from the final answer. At the present time the pilot and dispatcher must have full knowledge of weather conditions to be encountered during any flight in order to draw up a flight plan and so operate as to insure complete passenger safety.

In the direction of providing this knowledge regarding weather conditions, United Air Lines has for some time had a staff of young technical men working with the well-known Norwegian Air-Mass Analysis Method and has now set up a new department for this type of personnel which will work in conjunction with the United States Weather Bureau, Mr. Ables said.

It is the duty of the meteorologist, said Norman Hallanger, United Air Lines meteorologist, to acquaint the pilot and the dispatcher before each trip with a picture of the weather which is to be encountered. The information which he provides includes the presence of static, probable ice load, whether or not the trip is apt to be rough, wind direction and velocity, as well as other things which permit it to be determined whether the ship will fly above or below the clouds or through them by instruments. The meteorologist gets his information from weather reports coming in at hourly and less frequent intervals from ground stations and from flights already in the air. Key airports, he said, are now providing airplane observation flights to an altitude of about 16,000 or 17,000 ft. With all these data a meteorologist can make an analysis of the atmospheric structure and predict with good accuracy the conditions under which the flight is to be made, Mr. Hallanger declared.

In the discussion period following Mr. Hallanger's remarks, both he and Mr. Ables answered questions from the floor. The latter remarked that ice formation is due to cold water encountered in the air rather than solid ice particles formed before moisture strikes the ship. Mr. Hallanger pointed out that two air masses of different properties do not mix and that static and other disturbances are encountered at a point where these two air masses meet or what is termed discontinuity surfaces. In such zones static is apt to be very heavy and is usually confined to wet air, he said, adding it is believed that the static charge on the water particles splits and builds up a charge on the ship and this discharge is what causes static difficulty. Occasionally static is encountered in dry air but this is more or less unusual, he explained.

Following this discussion period W. F. McGinty, in charge of engineering, Boeing School of Aeronautics, presented a paper crediting the constant-speed propeller with "enabling startling increases in payloads and ranges by allowing aircraft designers to harness more highly supercharged engines to more heavily loaded airplanes, and still permit take-offs without excessively long runs." He added that they also are responsible for very acceptable increases in cruising speeds with the same power as when constant speed-propellers were used. Mr. McGinty then traced the development of the constant-speed propeller since before the World War.

Next the audience heard from Lloyd Stearman, president and manager of the Stearman-Hammond Aircraft Corp., of San Francisco, manufacturers of a small plane designed for private ownership which was the result of the recent Department of Commerce competition for an ultra-safe low-cost plane. Upon stating these facts briefly, Mr. Hammond called upon his chief engineer, M. C. Haddon, to speak regarding the type of plane which his concern manufactures.

Mr. Haddon pointed out that there has been a promising upturn in the demand for privately owned planes. This is evidenced by the fact that during nine months last year some one thousand of such planes were sold while for a similar period this year, the figure had increased to 1900 planes. Mr. Haddon explained that the tricycle landing gear used in the Stearman-Hammond plane dated back to the early Wright Brothers plane, and therefore, no claim was made to originality. This type of landing gear, he said, is more foolproof than the conventional and is so constructed that approximately 80 per cent of the load falls on the two rear wheels and the steerable front wheel cares for the rest of the load. Such features as improved vision and one brake pedal, as used in modern automobiles, contribute materially to the absence of any tendency to ground loop, he said.

In the discussion period following Mr. Haddon's remarks, he brought out that while it had been the original Department of Commerce intention to produce a private airplane which could sell for about $700, it has been proven that with present material and labor costs, this is entirely impossible.

At the close of Mr. Haddon's remarks and discussion thereon, there was shown a moving picture covering a modern transcontinental flight in club and sleeper planes, presented through the courtesy of the United Air Lines.

Field Editors

Baltimore – Espy W. H. Williams
Buffalo – G. W. Miller
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cleveland – William G. Piwonka
Dayton – R. H. Henry
Detroit – William F. Sherman
Indiana – Harlow Hyde
Kansas City – No Appointment
Metropolitan – Leslie Peat
Milwaukee – Theodore L. Swansen
New England – J. T. Sullivan
No. California – C. W. Spring
Northwest – R. J. Hutchinson
Oregon – Sid Hammond
Philadelphia – H. E. Blank, Jr.
Pittsburgh – Murray Fahnestock
St. Louis – C. T. Schaefer
So. California – W. G. Chamberlin
So. New England – F. W. Mesinger
Syracuse – C. T. Doman
Washington – Capt. E. L. Cummings

Mellon Institute Studies Automotive Problems

● Pittsburgh

Aside from the now well-known fellowship on petroleum technology which is now in its 26th year of continuous operation, investigations bearing on automotive problems at the Mellon Institute of Industrial Research have included studies on anti-freeze, brake fluids, carbon black, coolant for motors, chrome-plated aluminum and degreasing of metals.

These were among the facts brought out by Dr. Lawrence W. Bass, assistant director of the Institute, in a paper which he presented Dec. 14 on the occasion of the SAE Pittsburgh Section's meeting at the Institute.

This special automotive work, Dr. Bass explained, is typical of similar researches which the Institute makes in a variety of fields. In 30 years of operation it has served through its Industrial Fellowship system more than 4000 companies and evolved about 650 new products and processes. Each Industrial Fellowship is established on an annual contract basis by an individual, company or association of manufacturers. The Institute building, including completely equipped laboratories of various kinds, embraces 6,500,000 cu. ft.

Discussing particularly the researches of automotive interest, Dr. Bass said in part:

"*Anti-freeze*—Shortly after the organization

of the Institute, a fellowship originally headed by G. O. Curme was founded by the Prest-O-Lite Co. for a fundamental study of acetylene. At that time, of course, acetylene lighting was of great importance, particularly in the vigorous young automobile industry. During this research, a new process was discovered for manufacturing the closely related compound, ethylene. The question of using this substance in industry presented an interesting chemico-economic problem. The World War offered a possible solution, for this compound is the starting material in the synthesis of mustard gas, but the termination of the war again rendered its usefulness problematical.

"Because it seemed likely that commercial applications for chemicals derived from ethylene might be developed, the Carbide and Carbon Chemicals Corp. was organized to investigate the possibilities. One of the first notable successes was the synthesis of ethylene glycol, which, among other uses, was speedily adopted as an anti-freeze for automobile radiators, under the name 'Prestone.'

"Brake Fluids.—A hydraulic pressure-transmitting fluid for the brake systems of automobiles and airplanes has recently been developed by R. R. Fulton. In addition to meeting the many exacting requirements necessary for this function, the product has the property, not possessed by other commercial fluids, of being completely miscible with all other brake fluids, both aqueous and non-aqueous.

"Carbon Black.—One of the important technical achievements in the manufacture of tires is the use of added materials, notably carbon black, for improving the wearing properties. Early in the history of the Institute a fellowship evolved the 'Thermatomic' process for the production of blacks that find special usage in rubber products.

"Equally important to the automobile industry is the use of carbon black as a pigment for lacquers and finishes. Within the past few years C. W. Sweitzer, on a fellowship sustained by the Columbian Carbon Co., has developed colloidally dispersed blacks—for example, 'Coblac'—which represent a revolutionary improvement in materials for this purpose. 'Covinylblak,' a recently evolved intermediate consisting of a colloidal dispersion of carbon black in 'Vinylite' resin, has also been favorably received by the lacquer and coatings industry.

"Coolant for Motors.—Closely related to the use of ethylene glycol in the permanent anti-freeze field, is its application as a high-temperature coolant. In this connection it is of special interest to the airplane engine designer, because it allows the production of motors with low frontal area and smaller cooling surfaces.

"Chrome-Plated Aluminum.—H. K. Work, during the period 1925-29, developed a process for the chrome-plating of aluminum which has been widely applied in the production of hub caps and other automobile parts.

"Degreasing of Metals.—The development of processes that made ethylene glycol available to industry made possible also the preparation of other useful organic chemicals, such as the chlorinated solvents. These materials are widely used for the vapor degreasing of metals, where their freedom from fire hazard is of value. Other chlorinated compounds are of importance to the automobile industry in the solvent refining of lubricating oils and in the production of tetraethyl lead.

"Petroleum Production and Refining.—The fellowship on petroleum technology is now in its twenty-sixth year of continuous operation. The work began in September, 1911, under the direction of R. F. Bacon, who later served as Director of the Institute during 1914-21. The studies were continued under B. T. Brooks until 1917, then under W. F. Faragher (subsequently assistant director of the Institute, 1923-26), and since 1923 under W. A. Gruse. Over this quarter-century 65 scientifically trained investigators, mostly chemists, have been engaged in studying the chemistry and technology of petroleum, chiefly from the point of view of refining and utilization.

"Between the years 1924 and 1934 a separate fellowship devoted to geophysical and chemical problems in the production of petroleum, under P. D. Foote, was maintained; this group was the forerunner of the greatly expanded research organization of the Gulf Research Corp. now located at Harmarville, Pa. Similarly, between 1920 and 1922, an associated Fellowship on American oil shale was in operation.

"The work of the fellowship on petroleum refining has covered a wide range of problems, including nearly all the ways in which petroleum and its derivatives are used. One of the first investigations was on the conversion of heavy oils into gasoline by cracking, and patent applications were filed as early as 1912. From the same period dates the important pioneer work of Brooks and Bacon on the fluorescent compounds in petroleum. Later Brooks published a fundamental contribution to the chemistry of sulfuric acid refining, particularly of cracked products.

"Publications by members of this fellowship during the 26 years of its operation include 4 books and 60 journal articles. Fifty-four United States patents and 26 foreign patents have been issued on inventions made by the personnel."

Appointments to Manly And Wright Committees

Dr. Oscar C. Bridgeman has been appointed by the Council to serve for a term of three years on the Manly Memorial Medal Board of Award. He will replace A. H. Roy Fedden whose term has expired. Continuing on the Board are C. F. Taylor, who will serve as chairman for 1938, and S. D. Heron.

H. J. E. Reid will serve a three year term on the Wright Brothers Medal Board of Award. He will take the place of E. P. Warner whose term has expired. Members continuing on the Board are S. J. Zand, chairman for 1938, and C. E. Stryker.

Features of Automatic Transmission Described

● New England

Frank E. H. Johnson, service executive of Noyes Buick Co., Boston, was the speaker at the January meeting of New England Section held at Walker Memorial Building, M.I.T., Cambridge, Tuesday evening, Jan. 11. Chairman John H. Walsh presided.

Mr. Johnson's topic was "Automatic Transmissions and New Suspensions." He used a 1938 Buick transmission and spring suspension to illustrate his talk. Starting with the transmission he outlined the features of that unit emphasizing that it is in no sense an overdrive.

Beginning with the selector lever he showed how it operates in the four positions covering the various speed ranges; also why it is necessary to use the clutch only in starting from a dead stop and shifting into reverse.

Mr. Johnson then turned to the new coil-spring suspension such as used by Buick. All its features in adding riding comfort, eliminating lubrication points and making for greater comfort in riding were told. With the assembly units he was able to explain the features more clearly.

Chairman John H. Walsh held a meeting of the entire Section Governing Board at a noon luncheon at which plans were discussed to increase the membership and to try to secure a larger attendance at the meetings. A committee was named to contact all distributors and dealers in Boston to request that service managers and their assistants be interested in becoming members.

Diederichs Talks on Automotive Metallurgy

● Philadelphia

W. J. Diederichs, metallurgist of the Autocar Co., Ardmore, Pa., presented an informal coverage of automotive metallurgy in a talk before the Philadelphia Section at its third meeting of the year 1937-1938, held at the Engineers Club, Dec. 8.

Concentrating mainly on the fundamentals underlying the heat treatment of steel parts, Mr. Diederichs explained that the term "metallurgy" correctly applies to the refining of metals from their ores, and that the science relating to the improvement of the mechanical qualities of steels by heat treatment should properly be called "physical metallurgy."

A clear conception of a solid solution, which plays an important part in heat-treatment phenomena, was given by the speaker with the explanation that at high temperatures the iron and carbon are in the solid solution state, and as the temperature is lowered the solubility of

(*Continued on page 42*)

A Candid From Canada

John S. Steele photo

Section Chairman W. E. McGraw (left) enjoys a story told by R. H. Combs. It also amuses Warren Hastings, secretary of the Section. The photograph was taken at the Canadian Section's Dec. 13 meeting at which Harry T. Woolson, then president of the Society, was guest of honor.

About SAE Members:

William B. Stout, president of the SAE in 1935, was presented with a life membership in the Society at the close of the Council meeting which took place at the Annual Meeting in Detroit last month. Harry T. Woolson, retiring president, made the presentation. At the close of the Annual Meeting Mr. Stout took office as chairman of the Past-Presidents Advisory Committee.

Arthur T. Murray has resigned as president of United American Bosch Corp., Springfield, Mass., in order to become associated with the Moore Drop Forging Co., of the same city, in an official capacity. He will continue as a director and as a member of the executive committee of United American Bosch.

James E. Gleason, president and general manager of the Gleason Works, Rochester, N. Y., was recently guest of honor at the 39th annual dinner of the Society of the Genesee held in New York.

M. L. Pulcher, who has been president of the Federal Motor Truck Co. since its formation

M. L. Pulcher
Retires

in 1911, has resigned and announced his intention to retire from business.

Dean M. Gillespie, president, Dean Gillespie & Co., recently was elected president of the Colorado Motor Car Dealers Association.

A. George W. Brown is equipment engineer with Jamaica Buses, Inc., Jamaica, Long Island.

Edward A. Johnston, vice-president and director of engineering, International Harvester Co., Chicago, has been selected as the recipient

E. A. Johnston
Medalist

of the 1938 Cyrus Hall McCormick Medal presented by the American Society of Agricultural Engineers for "exceptional and meritorious engineering achievement in agriculture."

Samuel P. Hess has been appointed sales manager, chassis spring division, Detroit Steel Products Co. He will be in charge of sales and engineering. Mr. Hess has been affiliated with the company for more than 25 years and was chief engineer of the division before taking his new office.

T. M. Robie has been named manager of the Diesel sales division of Fairbanks, Morse & Co., Chicago. He has been affiliated with the company since 1919 and was previously in charge of Diesel sales to resale manufacturers.

Beecroft to Represent SAE

When the 9th Annual Convention of the Greater New York Safety Council is held in New York, April 19-21, the Society will be represented by its treasurer, David Beecroft.

Z. C. Tatton probably traveled farther than anyone else to attend the Society's Annual Meeting. He represents the Texas Co. in New Zealand and had to travel some 10,000 miles to get to Detroit. He arrived in this country shortly before the new year started and visited SAE Headquarters in New York on his way to Detroit. It is his first trip to the United States and he will see a considerable portion of it as he plans to return to New Zealand by way of San Francisco.

James D. Mooney, president, General Motors Overseas Corp., addressed the All Engineers' Dinner sponsored by the American Engineering Council in Washington, D. C., Jan. 14. He spoke on "The Engineers' Opportunity in the United States in Comparison with Other Countries."

Carl H. Beck, for the past six years eastern manager of the Westinghouse Air Brake Co., has been promoted to the position of general sales manager of the company at Wilmerding, Pa.

Raymond P. Lansing has been named general manager and *Benjamin H. Gilpin,* plant manager of the New Jersey division of the Bendix Aviation Corp., at Bendix, N. J.

Col. William G. Wall, a past-president of the SAE, recently resigned as a member of the Contest Board of the American Automobile Association. He explains that because of having retired from professional work it is difficult for him to attend the meetings. He thinks it much better to have someone on the Board in his place who would be more active. He is spending the winter in Jamaica, West Indies.

Dr. Miller McClintock was one of three men who collaborated in making a report of the Advertising Research Foundation on the evaluation of window-display-advertising circulation and cost. The report was made following an 18-month study conducted in 19 different cities and communities in all sections of the country. Information and statistics were gathered on 16,587 window-display spaces exposed daily to 49,533,900 persons.

D. F. Malan, who was assistant inspector of roads for the Cape Provincial Administration, roads department, Cape Town, South Africa, has been advanced to the position of inspector of roads.

Robert W. Vinson has joined the Kupp Motor Co., Inc., Portland, Ore., as service manager. He was formerly mechanic with Wentworth & Irwin, Inc., of the same city.

James E. De Long, president and general manager, Waukesha Motor Co., sailed from New York the middle of last month for England. He experts to return early in March.

Villor P. Williams has been named vice-president and chief engineer of Pioneer Industries, Inc., New York. He also will continue as president and chief engineer of the Williams Engineering Corp., Baltimore, Md.

J. Edward Schipper, president Schipper Associates, Detroit, and publicity director of Hudson Motor Car Co., has been appointed a member of the Contest Board of the American Automobile Association.

Changes at Timken

Following the resignation of *Ernest Wooler* as chief engineer of The Timken Roller Bearing Co., *A. L. Bergstrom* has been appointed executive engineer to coordinate some of the varied activities of the company. Mr. Bergstrom has been affiliated with Timken since 1929, and before his recent advancement, was chief works engineer.

R. M. Riblet, who was previously assistant chief engineer of the company, has been named chief engineer of the automotive division.

Roos Joins Willys-Overland

Delmar G. Roos became vice-president in charge of engineering at Willys-Overland shortly after his return from England the middle of last month.

Mr. Roos was president of the SAE in 1934 and last year was chairman of the Past-Presidents Advisory Committee. He was for many years vice-president in charge of engineering for Studebaker. In England he served as consultant to Rootes Securities of London, which controls Humber, Hillman, Talbot, Sunbeam and Commer.

Mr. Roos is a graduate of Cornell University, with mechanical engineer and electrical engineer degrees. His automotive experience dates back to the days of the Locomobile Co., of which he was vice-president and chief engineer.

. . . . At Home and Abroad

L. B. Gilbert has been appointed branch manager of the White Motor Co.'s Chicago branch. He has been affiliated with White since graduating from the University of Illinois with

L. B. Gilbert
Promoted

the degree of Bachelor of Science in 1926. Since 1935 he has been Chicago sales manager. Mr. Gilbert is Chairman of the Chicago Section's Transportation & Maintenance and Truck, Bus & Railcar Committee.

Fred G. Wacker, Automotive Maintenance Machinery Co., has been elected president of the Motor and Equipment Manufacturers Association for the current year. Herbert L. Sharlock, Bendix Aviation Corp., is vice-president.

Charles L. Nein, formerly chief engineer of the Ward Motor Vehicle Co., Mt. Vernon, N. Y., has affiliated with Theurer Wagon Works, Inc., North Bergen, N. J.

John Karmazin is president of the Karmazin Engineering Co., Grosse Ile, Mich., and consulting engineer for Frigidaire Division and Harrison Radiator Division, General Motors Corp., in Dayton, Ohio, and Lockport, N. Y. He was formerly executive vice-president and chief engineer of the Heat Transfer Products Corp., Huntington, Ind.

John C. Estabrooke is salesman for the Queens Tire & Supply Co., Long Island City, N. Y. He was formerly assistant to purchasing agent, R. H. Macy & Co., New York.

Nelson B. Nelson, formerly sales engineer, New Departure Division of General Motors Corp., is now manufacturers' representative with headquarters in Milwaukee.

David L. Saxon has resigned as manager of the Steel Materials Co., Detroit, and has announced plans to open an office in Detroit as manufacturers' representative to the automotive and allied industries. He was with the Steel Materials Co. for more than four years and previously was one of the organizers and vice-president of the Saxon Stamping Co. of Toledo.

Robert H. Milbrath, who was previously lubrication engineer, Standard Oil Co. of New Jersey, is now affiliated with the West India Oil Co., S.A.P.A., with headquarters in Buenos Aires, Argentina. His new work started Feb. 1.

J. C. Knapp, formerly in the parts specifications department, Hudson Motor Car Co., Tilbury, Canada, is now in the Ford Motor Co. service department, Windsor, Canada.

O. Malychevitch has joined the Ford Motor Co., Dearborn, Mich., as design engineer. He was previously with the Diesel division of the Hercules Motors Corp., Canton, Ohio.

Seth B. Robinson, Jr., who was formerly assistant to manager, White Motor Co., in Boston, is now salesman for the Kinney Manufacturing Co. of the same city.

Everett M. Warren has joined Talon, Inc., Meadville, Pa., tool planning department. He was formerly with Motor Wheel Corp., Lansing, Mich.

R. E. Carlson has been elected a vice-president and director of Tung-Sol Lamp Works, Inc., with headquarters in Newark, N. J. Prior to his election he was manager of the company's Detroit division.

Henry J. Helfrich has joined the Houde Engineering Corp., Buffalo, as engineer. He was previously development engineer with the Truck Equipment Co., Inc., of the same city.

Harold Caminez is chief engineer of the Aircraft Screw Products Co., Brooklyn, N. Y.

Frank B. Sexton is president of the Frank B. Sexton Corp., sales engineers, with offices in Glendale, Calif. He was formerly manager of the marine division of the U.S.L. Battery Corp., New York.

James C. Reddig is development engineer with the Kenyon Instrument Co., Huntington, L. I., N. Y. He was formerly on the engineering staff of the Edo Aircraft Corp., College Point, Long Island.

Herbert Lee has resigned from the Light Production Co., Ltd., London, with whom he was service engineer, to take the post of technical manager, Harold Andrews Grinding Co., Ltd., Birmingham, England.

Herbert Lee
New Job

William Ernest England, former chief engineer of Willys-Overland, is consulting engineer for the American Bantam Car Co., Butler, Pa.

John W. Oehrli has joined the staff of the John Deere Tractor Co., Waterloo, Iowa, as design engineer. Before this change he was chief engineer with Lycoming Manufacturing Co., Williamsport, Pa.

Pilots Navy's Biggest Plane on Maiden Flight

On Dec. 17, 34 years almost to the minute after the Wright brothers made their memorable flight at Kitty Hawk, SAE Member William B. Wheatley took the Navy's first 30-ton flying destroyer on her maiden flight at San Diego. This big new ship is a far cry from the 274-lb. plane in which Orville and Wilbur Wright startled the world. The new plane cost $1,000,000 to build, while the Wrights' first plane cost less than $3,000.

Mr. Wheatley, who is chief of flight testing and service manager for Consolidated Aircraft Corp., builders of the flying boat, had the honor of being at the controls.

The ship's designation "XPB2Y-1" is translated by factory officials to mean "experimental patrol bomber, second type, built by Consolidated and the first ship of its type."

S. W. Gray has been named director of tractor sales and engineering by the Marvel-Schebler Carburetor Division of Borg-Warner Corp. He has been associated with the organization for many years, originally starting with the Wheeler-Schebler Carburetor Co. in 1923.

W. B. Hurley (see page 19 for picture) is now a staff engineer for the Detroit Edison Co. In his new capacity he will do more metallurgical work. He was previously sales engineer.

Harold P. Phillips, formerly chief service engineer, McQuay-Norris Manufacturing Co., St. Louis, Mo., is now affiliated with the Hastings Manufacturing Co., also in St. Louis.

Capt. Cyril Cadwell Lawton, Quartermaster Corps (Reserve), United States Army, has been appointed motor transportation inspector, Civilian Conservation Corps, Headquarters First Corps Area, Army Base, Boston. He was formerly assistant motor transport officer, Headquarters Third C.C.C. District, Fort Devens, Mass.

(*Continued on next page*)

Floyd E. Badger

Floyd E. Badger, who had been affiliated with the Detroit Steel Products Co. for more than 17 years, died on Dec. 9. He was sales manager of the chassis spring division, in charge of sales and engineering.

From 1910 until entering the United States Army as captain in the Motor Transport Corps, he was connected with the J. B. Armstrong Manufacturing Co., which later became the Armstrong Spring Co., a branch of the Standard Parts Co. After the War he was placed in charge of erecting and equipping a spring plant of the Standard Parts Co. at Flint, Mich., and was later made general manager of the company's Canton, Ohio, spring plant. It was from this position that he joined the Detroit Steel Products Co.

Mr. Badger had been a member of the Society since 1915. He was born in 1886 at Angola, Ind., and had high school and business education.

Henry Gulick

Henry Gulick, president of Gulick-Henderson Co., Inc., New York, died on Oct. 28. Mr. Gulick had been a member of the Society since 1917 and had been engaged as a consulting and inspecting engineer for 37 years, allotting much of his time to determining the quality, fitness and suitability of materials for automobiles. He was born in Cincinnati, Ohio, in 1863.

Stanley Krall

Stanley Krall, manager of the product development department of the Fisk Rubber Corp., Chicopee Falls, Mass., died at his home in Longmeadow, Mass., Nov. 22, after a brief illness.

Since his graduation from the Case School of Applied Science with a B.S. degree in 1916, Mr. Krall had been affiliated with the tire industry. His first position was that of chemist with Firestone Tire & Rubber Co. from 1916 to 1924. He was then development manager for the Mason Tire & Rubber Co. for approximately one year before joining Fisk where he was director of research and chief chemist as well as manager, product development.

Mr. Krall was born in Detroit in 1894. He became a member of the Society in 1936.

John F. Haines, former acronautical experimental engineer, Steel Products Engineering Co., Springfield, Ohio, has joined the staff of Engineering Projects, Inc., Toledo, as designing engineer.

Raymond P. Johnson, who has been supervisor of distribution, Socony-Vacuum Oil Co., Inc., at Buffalo, has been transferred to Albany where he will be on the operating department staff.

Livingston Disbrow, who was engineer with Rototiller, Inc., Long Island City, N. Y., is now design engineer with Cummins Diesel Engine Corp., New York.

Chien Kao is special apprentice with the White Motor Co., Cleveland. He was formerly tool designer with General Motors Truck Co., Pontiac, Mich.

Norman E. Carlson is instructor at the Lane Technical High School, Chicago. He was previously sales engineer, Sealed Power Corp., Muskegon, Mich.

News of the Society

(*Continued from page 39*)

free ferrite in austenite decreases and some of it precipitates out.

With regard to the tempering process, Mr. Diederichs stated that its object is to increase the ductility at the expense of some loss in tensile strength and hardness. The special problem presented when both high hardness or wear resistance and high ductility are desired can be met by carburizing low-carbon steel and quenching.

Use of Babbitt Metal Called Traditional

● **No. California**

Babbitt metal has been used for bearings for just one year under a century, R. A. Watson, service engineer, Federal Mogul Corp., told members of the Northern California Section, at its Jan. 11 meeting. "Unfortunately," he said, "age is not a measure of our knowledge of this metal, and we must admit its use was traditional rather than the result of careful technical investigation."

The reason for this, he continued, is that it has been only recently that the increased burden on the bearings of our machines has forced us to investigate the properties of our bearing materials.

Emphasizing that the processing of bearing alloys is just as important as heat treating steel, Mr. Waton spoke of the different methods of processing the alloys and applying them.

He spoke of the steel-back bearings as now processed as superior to any Babbitt bearings earlier developed. He noted, however, that there is a limit to the speeds and loads under which Babbitt will function and recommends that for pressures exceeding 1400 lb. per sq. in. and a velocity of over 40,000, that cadmium alloys or copper-lead be used. In some cases, he said, a lead-base metal, such as is used in several high-duty Diesel engines, will function at pressures up to 1700 lb. per sq. in.

Mr. Watson noted that new bearing alloys have been the cause of much concern to the oil companies. Cadmium alloys and copper-lead, he said, have shown tendencies to corrode with some oils under extreme heat conditions. However, he added, with standard brands of oils recommended by producers, his company has encountered very little trouble.

Before concluding his paper Mr. Watson stated: "We do not agree with people who recommend long intervals between oil changes. . . . Oil filters are good up to a certain point. . . . We believe efficient air cleaners are more important when properly serviced. . . . Nothing will take the place of a good old-fashioned oil change and a thorough flushing out of the crankcase before a refill."

After reading his paper Mr. Watson showed some 25 lantern slides which illustrated bearing difficulties encountered because of careless or inaccurate workmanship, both in bearing manufacture and bearing installation.

In answer to discussion from the floor Mr. Watson commented that detonation definitely causes bearing difficulty, both in main and connecting rod bearings. In the case of the latter, the top half usually shows failure due to highly localized overloaded areas.

Responsible also for bearing failure is excessive lugging of engines and over-speeding, particularly when using the engine as a brake, Mr. Watson declared. Under the latter condition and despite the fact that the bearing cap is called upon to take greater loads, the failures are usually in the rods, possibly due to the fact that the caps will wrap around the connecting rod and assume proper shape to insure even distribution of the load where the rod itself will spread and cause localized high loading, he added.

There was considerable discussion on the matter of low viscosity crankcase oils as compared to the old tendency when an SAE 40 was considered the very lightest which could be used in an engine. Mr. Watson stressed the desirability of avoiding the use of too heavy an oil and pointed out that high oil pressure does not mean oil circulation and that without oil circulation bearings fail due to rupture of the oil film or the inability of the generated heat to be conducted away.

The question of oil grooving was also commented on and Mr. Watson stated that it is his practice to recommend a single circular groove in the center of the bearing with a slight groove at the parting line extending to within about ⅛ in. from the bearing edges. Care should be taken to see that there are no sharp edges which will serve to wipe off the oil film, he said.

Speaking of crankcase temperatures, it was Mr. Watson's observation that bearing temperatures are probably in the neighborhood of 35 deg. Fahr. above measured crankcase oil temperatures. He emphasized the fact that crankcase temperatures above 275 deg. Fahr. means trouble and should be absolutely avoided.

Wolf SAE Delegate to Australian Celebration

George W. Wolf, assistant general manager of General Motors Export Division, will be official SAE delegate to the five-day meeting which the Institution of Automotive Engineers (Australia) is holding in Sydney, March 7-11, as a part of the Australian Government's program celebrating the country's 150th Anniversary. James Fielder, Australian member of the SAE Overseas Relations Committee, will be the Society's local representative.

The SAE Council has expressed the Society's sincere best wishes to the Institution of Automotive Engineers "in connection with this important undertaking and the advancement of the art in Australia."

40 Student Members Visit Olds Motor Works

● **G.M.I.**

The Student Branch at General Motors Institute made its first field trip of the current year on Nov. 30, when 40 members motored from Flint to Lansing to visit the Olds Motor Works. This is the largest number ever to make a trip of this kind.

In the forenoon the six- and eight-cylinder-motor plants were inspected, followed by a showing of motion pictures depicting the history and policies of the Olds Motor Works.

At noon the company was host to the group at a dinner served in the plant cafeteria. The afternoon was devoted to an inspection of the sheet metal plant, heat treatment department, the final assembly line, and the engineering building.

About Authors

(*Continued from page 11*)

Cumming took part in designing at Goodyear. When approximately 100 six-wheel vehicles were sold to the Surface Transportation Co. ten years ago, he accepted the responsibility of operating them and has continued with that company to date.

● **A. Lewis MacClain** ***enlisted for pilot's training in the Army in 1917 while a senior at Whitworth College, Spokane, Wash. After training at Mather Field, Brooks Field, and instructing at Kelly Field, he returned to civil life and entered the University of Washington in 1919 and qualified for a B.S. degree in general science in 1920. He then entered the U. of W. College of Engineering as an advance freshman and received a B.S. degree in mechanical engineering in 1925. While attending the University he earned enough as a street-car operator to carry him through a year at Massachusetts Institute of Technology where he received a degree of M.S. in aeronautics. He maintained his flying status as a Reserve Officer and after a year of student instruction at the Boston Airport received employment in his present position as Pratt & Whitney's chief test pilot. He holds the rank of captain and position of engineering officer of the 43rd Division Aviation, Connecticut National Guard, and, as one of their pilots on a military training flight, made the trip to Los Angeles in a National Guard airplane to attend the SAE National Aircraft Production Meeting.***

● **John G. Moxey,** ***after graduating from the University of Pennsylvania in mechanical engineering, followed steam and electrical engineering practically before entering the oil industry in 1912. He first became associated with motor truck work in 1915 and has been constantly engaged in motor transportation since then, taking active charge of his first fleet in 1921. For the past five years Mr. Moxey has been connected with the Sun Oil Co. in the capacity of transportation engineer.***

● **D. A. Wallace** ***was born on a ranch in Kansas. Starting out as a machinist apprentice in railroad work his varied career has taken him to Texas as service representative for Buick and to Mexico during the Madero-Villa Revolution, in charge of mechanical operations for Corrigan-McKinney Corp.'s mining developments. He was later chief tool designer and master mechanic for Hart-Parr, and during 1916 and 1917 was with a plant making shells and gun mounts for the British. When the United States entered the War he joined the Motor Transport Corps, and became a captain before he left the service in 1919. From 1919, until he joined Chrysler Corp. as staff master mechanic in 1929, he was master mechanic and general superintendent of the John Deere Tractor Co. Besides being president of the Chrysler Sales Division. Mr. Wallace is also president of Chrysler's Marine Engine Division and of the Chrysler subsidiary, Pekin Wood Products Co. Helena, Ark.***

Personnel of 1938 SAE Committees

PRESIDENT C. W. Spicer announces the following appointments on the Administrative Committees of the Society and the personnel of the Professional Activities, Technical and Special Committees for 1938.

These include the Research Committee and its Subcommittees, the Standards Committee and its Divisions, the Society's Special Committees and Cooperative Committees on which the Society is represented with other organizations. Acceptance of their appointment has been received from virtually all of those named.

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W. E. John	Motorboat & Marine Engine
M. C. Horine	Motorcoach & Motor Truck
P. V. Faragher	Non-Ferrous Metals
W. C. Keys	Parts & Fittings
G. L. McCain	Passenger Car
W. B. Hurley	Production
E. H. Ehrman	Screw Threads
G. W. Curtis	Tractor & Equipment
F. L. Faulkner	Transportation

DIVISIONS OF S.A.E. STANDARDS COMMITTEE

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I. M. Laddon, *Vice-Chairman*

F. O. Carroll — F. G. Gardner
J. R. Cautley — H. L. Haushalter
C. H. Colvin — J. G. Kuhn
C. F. Cotton — C. J. McCarthy
T. P. Wright

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N. N. Tilley, *Vice-Chairman*

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W. F. Davis — Robert Insley
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R. M. Hazen — Ludwig Majneri
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George Walther, *Vice-Chairman*

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C. L. Eksergian — O. A. Parker
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A. F. Milbrath — J. C. A. Straub
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H. T. Chandler — John Mitchell
A. T. Colwell — J. G. Morrow
A. H. d'Arcambal — H. T. Morton
B. H. DeLong — J. H. Nead
N. L. Deuble — R. B. Schenck
H. J. Fischbeck — P. J. Smith
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A. L. Clayden — R. P. Lewis
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C. E. Earle — K. G. Mackenzie
F. L. Faulkner — A. G. Marshall
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C. E. Frudden — Elmer McCormick
J. G. Geniesse — Gordon McIntyre
F. K. Glynn — G. L. Neely
M. D. Gjerde — H. M. Northrup
H. C. Gooch — F. J. Philippbar
W. H. Graves — D. G. Proudfoot
L. B. Helm — G. A. Round
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J. B. Fisher — F. L. Sage
C. O. Guernsey — H. E. Simi
L. P. Kalb — T. C. Smith

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W. H. Graves, *Vice-Chairman*

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D. L. Colwell — H. C. Mougey
W. A. Cowan — J. V. O. Palm
J. B. Johnson — E. W. Upham
L. M. Long — A. E. Weiss
T. H. Wickenden

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G. L. McCain — William Wagstaff
H. M. Northrup — J. J. Wharam
F. G. Whittington

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R. E. Cole — K. M. Wise
G. A. Delaney — J. J. Wharam

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D. A. Wallace

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E. J. Bryant — G. S. Case
C. T. Doman

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J. M. Davies — C. D. Peterson
O. E. Eggen — Lester Pfost
J. S. Erskine — R. M. Schaefer
S. W. Gray — W. F. Strehlow
William Lowther — Benjamin Van Zee

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W. J. Cumming — H. E. Oszman
H. R. Holder — E. S. Pardoe
Adrian Hughes — T. C. Smith
A. A. Lyman — M. F. Steinberger

PATENTS COMMITTEE

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G. C. Arvedson — M. W. McConkey

COMMITTEE ON METHODS OF EXPRESSING LIMITS AND TOLERANCES

Earle Buckingham, *Chairman*

E. H. Ehrman — C. W. Spicer

STANDARDIZATION POLICY COMMITTEE

(See General Standards Committee)

Memorial Committees

MANLY MEMORIAL MEDAL BOARD OF AWARD

C. F. Taylor, *Chairman*

O. C. Bridgeman — S. D. Heron

Awards

1928 S. D. Heron
1929 No award
1930 O. C. Bridgeman
1931 No award
1932 F. L. Prescott
1933 A. H. Roy Fedden
1934 Rex B. Beisel, A. Lewis MacClain, F. M. Thomas
1935 G. E. Beardsley, Jr.
1936 R. W. Young

WRIGHT BROTHERS MEDAL BOARD OF AWARD

S. J. Zand, *Chairman*

Carleton E. Stryker — H. J. E. Reid

Awards

1928 C. H. Havill
1929 R. H. Upson
1930 T. P. Wright
1931 S. J. Zand
1932 E. P. Warner
1933 E. N. Jacobs
1934 Rex B. Beisel, A. Lewis MacClain, F. M. Thomas
1935 William Littlewood
1936 J. K. Ball, F. P. Laudan, R. J. Minshall

Representatives on Other Organizations and Committees

ADVISORY BOARD OF THE GOVERNMENT TECHNICAL COMMITTEE ON LUBRICANTS AND LIQUID FUELS

C. F. Kettering

AMERICAN BUREAU OF WELDING

E. J. W. Ragsdale

AMERICAN COMMITTEE ON THE MARKING OF OBSTRUCTIONS TO AIR NAVIGATION

G. W. Lewis

AMERICAN DOCUMENTATION INSTITUTE

H. K. Cummings

AMERICAN FOUNDRYMEN'S ASSOCIATION

Alloy Cast Iron Committee

F. E. McCleary

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Research Committee on Cutting of Metals

W. H. McCoy
F. W. Cederleaf (Alternate)

AMERICAN SOCIETY FOR TESTING MATERIALS

Committee A1 on Steels

F. P. Gilligan

Subcommittee VIII on Steel Castings

F. P. Gilligan

Subcommittee XIX on Sheet Steel and Steel Sheets

J. M. Watson

Committee A3 on Cast Iron and Subcommittee XVIII on Automotive Castings

F. E. McCleary

Committee A7 on Malleable Castings

H. T. Chandler

Committee B2 on Non-Ferrous Metals and Alloys

W. H. Graves

Committee B6 on Die-Cast Metals and Alloys

D. L. Colwell

Committee B7 on Light Metals and Alloys

P. V. Faragher

Committee D2 on Petroleum Products and Lubricants

H. C. Mougey

Committee D11 on Rubber Products

F. W. Sampson

Subcommittee XI on Chemical Analysis of Rubber Products

F. W. Sampson

Subcommittee XVII on Rubber Products for Absorbing Vibration

F. W. Sampson

Subcommittee XX on Adhesion Tests

F. W. Sampson

Committee E1-Section on Tension Testing

F. P. Gilligan (Alternate)

Committee E3 on Chemical Analysis of Metals

J. R. Adams

AMERICAN STANDARDS ASSOCIATION

Standards Council

F. K. Glynn — A. M. Wolf (Alternate)

Mechanical Standards Committee

F. K. Glynn — A. M. Wolf (Alternate)

AMERICAN SOCIETY OF SAFETY ENGINEERS

J. W. Lord

AMERICAN TRANSIT ASSOCIATION

Motor Bus Division

Development of Bus Equipment Committee

C. O. Guernsey — A. J. Scaife

Maintenance of Bus Equipment Committee

E. W. Stock — H. L. Debbink

ARMY AND NAVY JOINT STANDARDS CONFERENCES

J. F. Hardecker

AUTOMOTIVE EDUCATIONAL COMMISSION

Advisory Board on Industrial Education of Board of Education, New York City

S. G. Tilden

ENGINEERING FOUNDATION

Iron Alloys Research Committee

T. H. Wickenden

FEDERAL SPECIFICATIONS BOARD

Committee on Storage Batteries

L. E. Lighton

GUGGENHEIM MEDAL BOARD OF JUDGES

C. H. Chatfield — T. N. Joyce*
G. W. Lewis

JOINT A.S.M., A.S.T.M., AND S.A.E. COMMITTEE ON DEFINITIONS OF HEAT TREATMENT TERMS

E. F. Davis — G. L. Norris
R. B. Schenck

NATIONAL RESEARCH COUNCIL

Highway Research Board

B. B. Bachman — T. C. Smith

Advisory Committee of Highway Research Board

A. J. Schamehorn

Engineering and Industrial Division

Arthur Nutt — Carl Breer†

NATIONAL SAFETY COUNCIL

Greater New York Safety Conference

David Beecroft

RADIO MANUFACTURERS ASSOCIATION

Committee for Reduction of Radio Interference

J. T. Fitzsimmons — P. J. Kent
L. H. Middleton

* Term expires May 1, 1938.
† Term expires July 1, 1938.

Reports of Committees

Meetings Committee Report

THE following meetings, National, National-Regional, and Section-Regional, exclusive of regular Section meetings, comprise the meetings program of the Society for the 1937 administrative year, the period extending from the close of the 1937 Annual Meeting to the close of the 1938 Annual Meeting.

Meeting	Place	Date	No. of Sessions	No. of Papers	Attendance
Aeronautic	Washington, D. C.	March 11-12	7	16	263
Transportation*	Baltimore, Md.	April 15-16	6	11	223
Tractor†	Peoria, Ill.	April 21-23	4	6	343
Summer	White Sulphur Springs	May 4-9	14	31	614
Tractor*	Akron, Ohio	Sept. 15-17	6	9	281
Transportation*	Chicago, Ill.	Sept. 29-Oct. 1	5	6	314
Fuels and Lubricants†	Tulsa, Okla.	Sept. 30-Oct. 1	6	11	95
Aircraft Production	Los Angeles	Oct. 7-9	7	15	629
Annual Dinner	New York City	Oct. 28	1	1	1028
Transportation*	Newark, N. J.	Nov. 9-10	4	7	315
Transportation*	San Francisco	Nov. 18-19	7	10	170
Production	Flint, Mich.	Dec. 8-10	6	11	425
Annual	Detroit	Jan. 10-14	18	32	

*Section Regional
†National Regional

The Meetings Committee was in charge of general arrangements for the Annual Meeting and the Summer Meeting, and the technical sessions at these meetings were handled mainly by the Professional Activities. The Annual Dinner was under the general supervision of the Meetings Committee, with the assistance of a special Dinner Committee to take care of details.

The Engineering Display, which has been held in connection with the Annual Meetings in previous years, was repeated at the 1938 Annual Meeting, giving to various companies the opportunity to exhibit their products and to disseminate technical information to the engineers attending the Annual Meeting.

The Meetings Committee has encouraged the holding of Regional meetings during 1937, as reported under the work of the Sections Committee. Unusually fine cooperation has been received from the Sections during the past year in connection with the various National and Regional meetings held in their respective territories. The Meetings Committee takes this opportunity to thank the Baltimore, Chicago, Cleveland, Detroit, Metropolitan, Northern California, Northwest, Oregon, Southern California and Washington Sections for their assistance.

—H. W. ALDEN, *Chairman*

Membership Committee Report

THE year 1937 showed a growth in membership commensurate with the increased activities of the Society, as evidenced by the figures submitted below:

	1936 (as of Dec. 31)	1937 (as of Dec. 31)
Members	2,779	2,963
Associates	1,337	1,451
Juniors	355	423
Foreign Members	377	392
Service Members	90	87
Departmental Members	3	5
Affiliate Members	71	76
Additional Affiliate Member Representatives	31	37
	5,043	5,434
Enrolled Students	304	433
	5,347	5,867

The peak for the past seven years has been reached in the number of applications received, which is the result of the diligent work and hearty cooperation of the National and Section Membership Committees.

Student enrollment shows a substantial increase over the previous year.

The Membership Committee takes this opportunity to express its sincere appreciation to the Sections and to the individual members of the Society who have assisted in the work and made this growth possible.

—A. L. BEALL, *Chairman*

Publication Committee Report

THE Publication Committee, with the cooperation of special committees of volunteer readers representing each of the activities of the Society, during the past year has maintained a high quality in the papers selected for printing.

During the calendar year of 1937, 932 pages of text and 637 pages of revenue advertising were published in the JOURNAL. Of the text pages, 625 or approximately 67 per cent consisted of papers and discussion; 596 of these pages were published in the Transactions Section. During the preceding year, 1936, 910 pages of text were published, of which 563 or 62 per cent consisted of papers and discussions. The increased number and scope of the regional and general meetings of the Society in 1937, as compared to 1936, developed a larger number of papers and accounts for the larger proportion of pages devoted to formal papers and discussions. In 1936, there were published 596 pages of revenue advertising.

Seventy-nine complete papers, some with discussion, and one discussion printed separately, were published during the year 1937. In addition, there were published three special articles, all of which dealt with technical problems.

In addition, 21½ pages of the JOURNAL were devoted to printing for purposes of record, brief abstracts of all papers presented at the various general and Section meetings of the Society. This practice was begun immediately following the 1934 Semi-Annual Meeting and is being continued as a regular part of the JOURNAL program.

Transactions

Transactions of the Society were brought up to date by publication about the middle of February of Volume 31 covering the year 1936. In this volume there were 538 pages. It contained 63 complete papers and discussions and one discussion printed separately.

Volume 31 was sold to members for $2, the charge being entered upon the bill for annual dues.

Roster

The SAE Roster for 1937 contained the same number of pages as the 1936 edition, names of members on our Reserve Membership List having been omitted.

The Roster for 1938 will be issued about the middle of February and will be similar in all respects to last year's book.

—JOHN H. HUNT, *Chairman*

Research Committee Report

A GROWING number of research undertakings and increased activity on some of the continued projects during the past year have occasioned the holding of over 70 formal committee and group meetings, for which minutes were prepared, and numerous other informal group conferences. Only the highlights of the year's accomplishments in the Society's research are touched upon in this report.

Crankcase Oil Oiliness

The term "oiliness" has been defined and consideration given to terminology in connection with wear and seizure measurements.

Work has continued on the program of engine tests to determine whether or not it is possible to show an advantage in the use of oiliness agents as an addition to mineral oil under engine operating conditions. The tests are being conducted on two test oils prepared under the direction of the Committee, a mineral oil and the same oil compounded with sperm oil. About one-third of the participating laboratories have reported and the results are being analyzed.

In the formulation of a future program consideration is being given to a proposal involving the application to wear tests of the supercharged C.F.R. Engine with wet-liner cylinder.

Crankcase Oil Stability

Thirteen laboratories are cooperating in a series of stability tests on oils suitable for both automobile and aircraft use, the majority being commercial oils on which service data are available. The samples are identified by code number only, and the results will be reported in accordance with a uniform method of reporting adopted by the Committee.

Extreme-Pressure Lubricants

During the past year the production by the Highway Trailer Co. of a third lot of the SAE Extreme-Pressure Lubricants Testing Machines was authorized by the Extreme-Pressure Lubri-

cants Research Committee to meet a current demand, and 14 individual orders received approval by the Executive Committee. These machines have recently been delivered, bringing to 45 the total number of machines now in use.

At its May meeting the Committee adopted, as a tentative standard method, a revised procedure for operating the machine, and inaugurated a cooperative program of tests on three lubricants to check the performance of the second lot of 10 machines with the first lot of 21. The analysis of results received to date is in progress.

The subcommittee on procedure for wear tests, by action of the Committee, was enlarged and instructed to collect and analyze wear data on extreme-pressure lubricants obtained both in service and on test machines. An appeal was circulated to 177 prospective sources of such data; 132 replies have been received, 25 of which represent useful contributions. A preliminary study of these data is now in progress as the first step in the preparation of a complete committee report.

Twenty-two motor-vehicle operators have responded to an invitation to participate in a study of the stability of extreme-pressure lubricants as regards their tendency to change or break down in service. Samples of various kinds of extreme-pressure lubricants, in different types of service, used in many types of vehicle are being collected from the participating operators and arrangements have been made for a cooperative program with the special subcommittee delegated to study corrosion of extreme-pressure lubricants.

Front-Wheel Alignment

The Front-Wheel Alignment Research Committee at its January 1937 meeting voted to discontinue its collection and dissemination of motor manufacturers' yearly wheel-alignment specifications because it is believed that this service is now being adequately handled by other agencies.

The Committee has continued its cooperation with the Highways Research Committee in formulating the wheel-alignment phase of the recommended procedure for motor-vehicle inspection, particularly in developing a recommended procedure for inspection of the steering mechanism.

Highways Research

Pursuing the policy that the Society lend its support to the programs of existing agencies now engaged in organized studies of the causes of accidents rather than plan independent and unrelated research, the Highways Research Committee was authorized early in the year to participate in a study of fleet accident data – a cooperative project with the Highways Research Board of the National Research Council, the National Bureau of Public Roads, and the Harvard University Bureau for Street Traffic Research – to determine whether these accident data furnish an adequate basis on which to arrive at proximate accident causes as related to vehicle design, construction, maintenance and operation. A preliminary survey of accident data recorded by eight fleet operators was covered in a report approved by the Society's Council as a contribution by the Society to the work of the Highways Research Board.

A subcommittee on trailer couplings has completed its work and as a result of almost two years of research, conducted with the cooperation and with the practically unanimous approval of the trailer manufacturers and users in the United States, has developed Recommended Safety Features Involving Trailer Couplings which has been submitted to the members of the Highways Research Committee for consideration and comment.

Ignition

The presentation at the Society's 1937 Summer Meeting of the report, "An Investigation of Mica Spark Plugs," by M. F. Peters, H. K. King and J. P. Boston, and an accompanying report, entitled: "Electrical Character of the Spark Discharge of Automotive Ignition Systems," closes, so far as the Committee and the Society are concerned at present, the spark plug investigation conducted at the National Bureau of Standards under the guidance of this Committee.

Two subcommittees have studied specification requirements of high-tension ignition cable for road vehicles and aircraft engines, respectively, and presented to the Committee preliminary drafts of proposed performance specifications.

The work of a special subcommittee on method of test for rating road vehicle spark plugs has progressed sufficiently to justify the exchange of results between cooperating members.

Riding Comfort

In an effort to clarify the diversified opinions concerning the question of research on ways and means for measuring the relation of seat cushions to riding comfort, arrangements have been made for the preparation of a series of articles reviewing and bringing up to date the present status of riding-comfort measurements as affected by seat cushions. These articles will cover academic theory, practical requirements of motor car manufacturers, and a review of the situation abroad, and will be accompanied by a bibliography.

It is the hope of the Committee that provision can be made for presentation of these reports at a suitable session of a national meeting of the Society.

Through the courtesy of Prof. J. M. Nickelson and Prof. W. E. Lay and the financial sponsor of seat cushion research work being conducted at the University of Michigan, an advance confidential report of the work in progress was made available to the Riding Comfort Research Committee.

Textile Research

The need for controlling shade variations in automobile trim cloth was brought before the General Research Committee early in 1936 and a special committee was delegated to investigate the need for research on this subject. As an outgrowth of the informal activities of this committee a series of joint meetings were held of the representatives of the automotive industry, represented through the Society, and members of the Textile Foundation and National Association of Wool Manufacturers. The textile industry, now more keenly aware of the importance of the problem, has taken steps to carry out the required research to improve the general situation.

Aircraft Engine Lubricants

The Society's Fuels and Lubricants Activity Committee at an informal meeting held on March 11, 1937, considered the possibility of offering some assistance through a committee in improving the present chaotic situation relative to aircraft lubricants, involving a multitude of difficulties and conflicting ideas, attitudes and requirements. Following general discussion, an informal group was delegated to investigate and report on the problems which could properly be investigated by such a committee, there being no intention to duplicate but rather to cooperate with, and supplement the work of, the National Advisory Committee for Aeronautics and the National Bureau of Standards in this field.

The preliminary survey and work of the informal group having indicated that worthwhile work can be accomplished within the Society's organization on the subject of aircraft-engine lubricants, the General Research Committee, upon recommendation of the Fuels and Lubricants Activity and Aircraft Engine Activity Committees, authorized the establishment of such a research committee. Accordingly, the Aircraft-Engine Lubricants Research Committee will hold its organization meeting during the Society's 1938 Annual Meeting.

Universal Test Engine

In cooperation with the interested research committees of the Society, the Waukesha Motor Co. has developed a crankcase for a prototype single-cylinder aircraft engine which was exhibited at the Summer Meeting. At that time a volunteer group met to offer suggestions for completing the design of a cooperative universal single-cylinder test engine, and a special design committee continued to assist in securing comments on the proposed design, and to embody all desirable changes in a series of revised layouts. Information concerning the unit was disseminated among the members of all interested committees, and the Waukesha Motor Company was urged to go into production on the basis of the fourth design revision. Five units are being built on the basis of orders received to date.

Cooperative Fuel Research

The work of the Cooperative Fuel Research Committee has been departmentalized into "Sections" as the first step in a plan of reorganization. The following Sections are now functioning under the C.F.R. Committee: Automotive Diesel Fuels, Aviation Fuels, Fuels Survey, Motor Fuels, Motor Survey, and Non-Petroleum Fuels.

The C.F.R. Committee recently approved an application to accept sponsorship of the work of the Volunteer Group on C.I. Fuel Research, and has accordingly formed an Automotive Diesel Fuels Section.

The Aviation Fuels Section has continued work on the full-scale detonation and laboratory detonation projects, and undertaken a program of vapor lock research. The cooperating engine manufacturers have pursued the program of full-scale engine testing of fuels in the high-octane bracket to investigate the apparent depreciation by the multi-cylinder engine of reference fuels without lead, and the stabilizing effect of lead in these reference fuels blended with 1, 2 and 4 cc. of lead, respectively. In its present program, as in previous work, the Committee has the cooperation of the Bureau of Aeronautics of the Navy Department, the Army Air Corps Materiel Division, and the National Research Council of Canada. Cooperative laboratory tests have been made on the test and reference fuels used in the full-scale work, and individual laboratories have contributed reports covering independent experimentation with supercharging, instrumentation, and interpretation of results.

A report summarizing the previous work on aviation vapor lock was prepared by the National Bureau of Standards as the first phase of the program intended to reveal the causes of vapor lock and to determine what changes in fuel system design will avoid this difficulty.

The Committee's representatives, as a second step in the program, have visited the plants of Douglas, Lockheed, North American, Vultee, Consolidated, and Boeing, where, through the cooperation of the Air Corps and the Bureau of Aeronautics, all available information was furnished to the Committee in furthering the survey of fuel systems in existing models of airplanes and in those which will be in production in the next few months. Similar inspections were made at the Naval Air Station at San Diego. Information gathered in this survey will provide the necessary basis for actual laboratory work in advance of a season of flight testing next summer.

The Committee has continued its cooperative agreement with the National Bureau of Mines whereby the Bureau completes the analysis of data collected by the Committee in a national motor gasoline survey, and issues a semi-annual report in mimeographed form covering the winter and summer gasolines sold throughout the country.

The work of the Fuels Survey Section has recently been expanded to include foreign motor fuels, and both domestic and foreign aviation fuels. Committee organization for handling this expansion of program has been worked out, and plans for program are being considered.

The foremost undertaking of the Motor Fuels Section during the past year has been a comprehensive study of the problem of correlation between car performance on the road and knock ratings made in the laboratory. In preparation for this work, an analysis was made of all available road test data on cars of 1934, 1935, and 1936 models. Coordinated programs of laboratory and road test work were carried out individually by the members of the C.F.R. Committee and its sections in cooperation with the Automotive Survey Committee of the American Petroleum Institute, covering a wide range of both winter and summer fuels. The results of this work to date are covered in two papers presented at the Society's 1938 Annual Meeting: "C.F.R. 1937 Road Knock Tests" by T. A. Boyd, and "Effect of Test Conditions on Fuel Rating, C.F.R. Report" by A. E. Becker. In this undertaking, the Committee has had the cooperation of a committee of the Institution of Petroleum Technologists working with British cars and British fuels.

Data made available through this study are being used as the basis for determining laboratory procedure which will correlate with road results obtained.

The Section has continued its study of factors affecting knock rating and investigated possible modifications in the C.F.R. knock testing engine and equipment with a view to further perfecting the test unit and procedure.

The Motor Fuels Section has continued to provide an opportunity twice yearly for all C.F.R. Engine owners, both domestic and foreign, to check their results on the C.F.R. Engine with the average of knock rating tests made by the members of the Exchange Group. Sixty-seven non-member laboratories participated in the last series of tests.

Tentative specifications for certifying the purity of the primary reference fuels, iso-octane and normal heptane, based on an investigation at the National Bureau of Standards, have been adopted.

As a result of the cooperative survey made a year ago, the Motor Survey Section revised its testing technique for obtaining the octane requirements of cars on the road and for determining vapor handling capacity, and has just completed, in cooperation with the A.P.I. Automotive Survey Committee, a survey of 1937 models. An analysis of the data obtained has been made at the National Bureau of Standards, and the results will be summarized in a statement shortly to be released to the press. Simultaneously with this release, more complete reports will be sent to each automobile manufacturer whose products were included in the survey with a decoding of results to each manufacturer on his own products only.

The C.F.R. Committee has approved the presentation at the Society's 1938 Annual Meeting of a summary report covering the progress on the motor survey work during 1937.

The Non-Petroleum Fuels Section, which has taken over the program of the former C.F.R. Subcommittee on Alcohol Gasoline Blends, has had no active projects during the past year.

—G. W. Lewis, *Chairman*

Treasurer's Report

FOR the third successive year the Society has shown a most creditable unexpended income after a period of four previous years of deficit.

For the fiscal year ended Sept. 30, 1937, the unexpended income was $22,998.95. The anticipated unexpended income by the budget was $11,955.00 so that the final figure was $11,043.95 better than the budget estimate.

This creditable showing was due largely to increased membership which brought increased dues, increased initiation fees and, indirectly, advances in other items of revenue. As a consequence, actual income was some $19,000.00 above the budgeted income.

On the expense side actual expenses exceeded budget estimates by some $8,000.00. Expanded Engineering Relations Committee activities, money for which became available by outside grants to the Society subsequent to the setting up of the 1936-37 budget, were primarily responsible for this $8,000.00 expended in excess of budget.

The figures at the top of the next column show in brief this past year's actual operations as compared with the budget and the figures for the previous year:

	Income	*Expenses*
1936-37 Actual	$267,616.24	$244,617.29
1936-37 Budget	248,500.00	236,545.00
1935-36 Actual	235,079.22	222,872.81

The comparative balance sheet and income and expense statements as of Sept. 30, 1937, which are a part of this report show in detail the Society's finances as of that date.

The investment portfolio of the Society was increased by $22,721.25 during the fiscal period, its total book value on Sept. 30, 1937, being $207,607.76. The actual market value of these securities on the same date was $8,085.99 above their book value.

—David Beecroft, *Treasurer*

BALANCE SHEET AS OF SEPTEMBER 30, 1937

Assets

Cash	$ 39,565.01
Accounts Receivable	5,833.46
Securities	*207,607.76
Accrued Interest on Securities	2,509.80
Inventories	806.80
Furniture and Fixtures	1,000.00
Items Paid in Advance, Charges Deferred	8,363.11
TOTAL ASSETS	$265,685.94

Liabilities and Reserves

Accounts Payable	$ 3,842.09
National Dues and Miscellaneous Items Received in Advance	19,408.18
Reserves Set Aside for Anticipated Expenses	8,466.77
General Reserve	210,969.95
Net Unexpended Income	22,998.95
TOTAL LIABILITIES AND RESERVES	$265,685.94

* Book Value (Market Value Sept. 30, 1937—$215,693.75).

INCOME AND EXPENSE AND BUDGET COMPARISON TWELVE MONTHS, ENDING SEPT. 30, 1937

Income	Oct. 1, 1936 to Sept. 30, 1937	Budget
Dues and Subscriptions	$ 78,437.80	$ 75,000.00
Initiation Fees	13,400.00	11,000.00
Interest and Discount	7,683.61	7,000.00
Affiliated Appropriation	16,875.00	7,500.00
Advertising – Journal	116,870.00	120,000.00
Advertising – Handbook	6,675.00	6,000.00
Miscellaneous Sales	23,144.88	22,000.00
Profit on Sale of Securities	2,608.95	.....
Unused Portion of Section Dues	1,921.00	.....
TOTAL INCOME	$267,616.24	$248,500.00
Expenses		
Research	$ 18,148.74	$ 15,785.00
Standards	8,142.55	7,975.00
Publications	48,460.03	47,150.00
Sections	7,178.49	9,080.00
Regional Meetings	1,007.65	1,500.00
Meetings	20,032.40	18,360.00
Institutional Promotion	1,231.32	3,000.00
Professional Activities	392.18	300.00
Membership Increase	12,234.69	11,750.00
Advertising – Journal	32,649.35	31,640.00
Advertising – Handbook	1,151.89	1,550.00
Miscellaneous Sales	9,796.54	9,310.00
General Expense	75,258.47	79,145.00
Engineering Relations	8,932.99	.....
TOTAL EXPENSE	$244,617.29	$236,545.00
Net Unexpected Income	22,998.95	11,955.00

Sections Committee Report

THE year 1937 has been one of progress and accomplishment for the 22 Sections of the Society. In addition to 170 regular Section meetings, many Sections participated in the various National and Regional Meetings sponsored by the Society, and gave freely of their cooperation.

A survey of the topics discussed at the regular monthly meetings of the Sections during the calendar year shows the following general subjects:

Passenger Cars	28
Aeronautics	22
*General	21
Trucks, Buses and Railcars	17
Diesel Engines	16
Traffic and Safety	15
Transportation and Maintenance	15
Fuels and Lubricants	10
Materials (automotive)	7
Parts and Equipment	7
Bodies	6
Research and Standardization	3
Student Meetings	3
Production	2
Racing Cars	2
Textiles	2
Tractor and Industrial Power Equipment	2
Cooling Systems	2
Lighter-than-Air Craft	2
Marine	1

*There were also 11 outings and 6 plant visits during the calendar year.

Section Meeting Attendance

There has been a general increase in attendance at individual meetings throughout the Sections, reaching a grand total of over 22,000.

Section Regional Meetings

The Canadian Section program included three Regional Meetings, one in Montreal, one in Windsor, and one in Oshawa. At the April 16 meeting in Windsor there was an attendance of 250.

Two Regional Meetings were held by the Indiana Section – one in Anderson and one in Lafayette.

The Northern California Section held two such meetings in Oakland, and the Baltimore Section held a meeting in Braddock Heights to which the Washington Section members were invited.

The Metropolitan Section held its Regional Transportation Meeting in Newark with an attendance of 315, the largest experienced since this meeting was placed on an annual basis.

The West Coast Regional Transportation Meeting, which was held in San Francisco, and in which the four Coast Sections participated, was a particularly successful event.

During the early part of 1937, SAE members in Oklahoma expressed the desire for Society activity in that territory, and accordingly a Fuels and Lubricants Regional Meeting was scheduled and held during the month of September with a considerable degree of success.

Closed Meetings

The "Closed Meeting" plan found new advocates during 1937. In addition to the Oregon and Detroit Sections, Chicago, Metropolitan and Southern California Sections have decided to schedule one or two meetings a year to which SAE members only will be invited.

Section Organization

One of the high spots of the year was the obvious consideration given to the appointment of the right Section member to the particular Committee post. In choosing Committee Chairmen for the administrative year, each Section Chairman evidently gave considerable thought to the qualifications most to be desired in the leader of each Committee, and consequently every Section has been operating with a full quota of active Committees ably equipped for the job.

Membership and Other Committee Work

Membership increase work has been actively carried on by the Sections. Some outstanding results have been achieved. The Section Membership Committees are to be commended for this energy and cooperation.

The same holds true in regard to the work of the Section Meetings Committees. A study of the Section Meetings Chart maintained at the headquarters office proves that each Meetings Committee Chairman gave particular thought to the type of papers most likely to appeal to his Section members. Many outstanding speakers were heard on subjects of vital interest to the industry today.

Reception Committees have been more active in greeting members and guests. Through the efforts of the Publicity Chairmen and the Field Editors, the JOURNAL has been better able to publicize the accomplishments of the Sections.

Local placement activities are being carried on by all the Sections where Placement Chairmen have been appointed, and they have cooperated very effectively with the Placement Service at the headquarters office to the interest of their unemployed local members.

Request for Regular Section

The Southern New England Section, which has been in the probationary status, has expressed its intention for applying for regular Section standing in view of its accomplishments during the past year and a half.

SAE Club of Colorado

The SAE Club of Colorado has had an active year. There is a movement on foot to enlarge the membership of the Club and to increase activities generally, so that there are concrete expectations in that quarter for a larger group.

Student Activities

Another SAE Student Branch has been added to the active groups already established, making a total of nine such Branches in accredited engineering schools. The SAE Student Branch at the University of Oklahoma is the newcomer, and will benefit greatly by the interest of the Tulsa group which has done much to foster student activities in the University.

There has been a noticeable increase in the number of applications for student enrollment received during the past year. Section cooperation with the students has been an outstanding factor, especially in the Cleveland, Detroit, Indiana, Metropolitan, Milwaukee, New England and Oregon Sections, where students are encouraged to participate in all Section affairs and are assisted in every practicable way. A recent survey shows that out of 55 student enrollments that expired in October, 1937, to date 21 have applied for Junior membership in the Society.

Section Visits

Every Section has been visited by a member of the headquarters staff during the calendar year 1937. In addition, President Woolson has addressed 11 Sections where warm receptions were accorded him.

* * *

Section officers in general have done a fine job during 1937. Many advancements recorded would not have been possible without their leadership and initiative, and this spirit of cooperation has prevailed throughout the year.

—F. K. GLYNN, *Chairman*

Standards Committee Report

THE organization and personnel of the Standards Committee are substantially as they were last year except for the appointment of some new members to succeed those who were no longer directly interested in the work of the Committees. The policy has been continued of selecting the most effective personnel for this work but of keeping the main Divisions as small as possible consistent with the best results. In general, preliminary work, especially of new projects, has been done by temporary Subdivisions and by general circularization, leaving the main Divisions freer to pass on the projects in their more advanced stages.

SAE Standards Committee

The activities during the year consisted largely of reviewing a number of the present standards to bring them up to date, and in formulating some new ones. The work was spread over a number of the Divisions and was of such a nature that it was handled largely by correspondence rather than by holding meetings.

The following are typical of the items on which the Standards Committee acted during the year. A new standard for an extra light series of ball bearings was approved for adoption both by the Ball and Roller Bearings Division and as the proposed American Standard, and the present standard wide type of bearings was supplemented by standard metric equivalents for the inch width dimensions. It is anticipated that both of these reports will be accepted internationally as the world standard. The standard for V-belts and pulleys that was completely revised about a year ago, was supplemented by drawings for the belt testing equipment so that both suppliers and users of V-belts can specify and test them on a comparable basis. The several specifications in the HANDBOOK for motor-vehicle lighting equipment were reviewed and modified to bring them in line so far as possible with current requirements and to make the specifications, where they apply, uniform for the several types of equipment. Study is still in progress on these specifications, particularly those for headlighting, with the cooperation of groups outside of the Society with the objective of eventually evolving more effective, safe headlighting to meet modern motor-vehicle operating requirements. In the field of lubricants further refinements in the classifications for both engine and transmission and rear axle lubricants have been studied in the Lubricants Division and part of this work was completed for adoption at the 1938 Annual Meeting.

The American Standard Code for Safety Glass for use in motor vehicles was revised during the year to include improved specifications for trade marking. This type of glass has come into almost universal use and is compulsory in most of the states and the Passenger Car Division has given considerable study to the state requirements and to proposed interstate commerce regulations governing for-hire motor vehicles in interstate operation.

In production engineering a revised SAE and American Standard for Twist Drills up to and including ½-in. diameter was submitted by the Sectional Committee on Small Tools and Machine Tool Elements and approved by the Society as one of the sponsors for this project under American Standards Association procedure. The American Standard for Roller Chains, Sprockets and Cutters was also supplemented during the year by Standard Symbols and Abbreviations for Chains and Sprockets that was approved by the Tractor and Equipment Division and the Society for inclusion in the American Standard originally approved and adopted in 1930.

The Tractor and Equipment Division during the year also approved revisions in the standards for tractor power take-offs and tractor drawbar adjustments and has work in progress

on tractor air cleaner tests and a standard definition and specification for No. 1 tractor fuel.

The latest field in which the Society has undertaken standardization is that of passenger-car trailers, in which the first definite standard for the coupling between the trailer and tow car was formulated during 1937. In this connection it is interesting to note that the Trailer Coach Committee of the American Association of Motor Vehicle Administrators recommended at the Association's meeting at Cincinnati on Oct. 1 that "specifications regarding strength of materials and type of joint shall conform to the recommendations of the Society of Automotive Engineers when said specifications have been formulated." At the time of preparing this report the proposed standard was in progress toward adoption by the Society and publication in the 1938 HANDBOOK.

A number of projects are under consideration by several Divisions that will necessarily carry over into the new administrative year, the more important ones being a renewed investigation of the possibility of standardizing engine and chassis number location; reviews of the SAE steel specifications and non-ferrous metal bearing standards; new standards for speedometer design and tests and a completely revised standard for suspension springs. The latter project includes also the first consideration of standard specifications relating to coil suspension springs.

Sectional Committees

The Society has continued its active participation in the work of Sectional Committees under the American Standards Association, both those for which it is a sponsor and those on which it is otherwise represented. The more active of these Committees in fields of direct concern to the automotive industries have been the Sectional Committee on Small Tools and Machine Tool Elements; the Sectional Committee on Power Transmission Chains, Sprockets and Cutters; the Sectional Committee on Ball and Roller Bearings, and the Sectional Committee on Safety Code for Specifications and Methods of Test for Safety Glass. On the recommendation of the Society, the American Standards Association cancelled the American Standard Aeronautic Safety Code (D1 – 1925) and discharged the Committee. This was done because of the obsolescence of this code and the fact that present governmental regulations are considered to adequately meet the requirements.

SAE Handbook

It is planned to issue a new 1938 edition of the SAE HANDBOOK to include the revisions that have been adopted on current standards and new standards adopted during the year, and it will be continued in substantially the same form as the 1937 edition. During the year a large number of the HANDBOOKS were sold and distributed here and abroad aside from those regularly sent to the members of the Society, and it is evident that its use as the standard guide in automotive engineering is greater than ever before and that many of the standards have become established in other industrial lines also.

General

Although the Society's activities in standardization work have continued to move forward, there have been some unavoidable factors that have made it necessary to devote the efforts of the Standards Committee members to those projects of greater general importance to the industries at large, but those of lesser importance including several new ones have been continued on the Standards Committee's docket.

There probably never was a time in our industrial history when the economic factors have assumed the relative importance that they do under present conditions. Inasmuch as the primary value of standards is economic, the mutual experience reflected in them and the increased benefits from their even wider use should not be overlooked by industrial management in deciding future programs that will be the basis of the work done by the engineering and manufacturing departments of their businesses. The Committees for formulating these standards and their procedure that are made possible through the Society are in the last analysis one of the major tools of industry that should be recognized and supported with as much consideration of their effective performance as is given to the development and use of powerful modern machine tools that have resulted primarily from the economic requirements in industrial activity.

—C. W. SPICER, *Chairman*

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 15, 1937, and Jan. 15, 1938.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ALLEN, W. H. (A) division manager, National Refining Co., Cleveland, O. (mail) 136 S. Eleanor Place, Peoria, Ill.

ARMINGTON, RAYMOND Q. (M) vice-president factory manager, Euclid Road Machinery Co., 1361 Chardon Road, Euclid, O. (mail) 3311 Maynard Road, Shaker Heights, O.

BENDER, RENE JOSE (M) fuel oil engineer, Sinclair Refining Co., 2540 W. Cermak Road, Chicago, Ill.

BERGSTROM, ALBERT L. (M) chief works engineer, Timken Roller Bearing Co., Canton, O.

BEVAN, GUY T. M. (M) chief engineer, Massey-Harris Co., Ltd., 915 King St., W., Toronto, Ontario, Canada.

BJORNSTAD, AAGE (A) manager sales department, Norsk Braendselolje A/S, Fred Olsensgt. 5, Oslo, Norway.

CAMPBELL, MALCOLM GEORGE (A) president, Kelsey Wheel Co., Ltd., 309 Ellis Ave., Windsor, Ontario, Canada.

CARY, BEECHER BANCROFT (J) development engineer, Hayes Industries, Inc., Fern & Wildwood Aves., Jackson, Mich. (mail) 114 N. Bowen St.

CONWELL, JOHN W. (J) chief experimental laboratory, Tide Water Associated Oil Co., Drumright, Okla. (mail) Box 1118.

CROWELL, PRESTON (A) special representative, government, specialty department, B. F. Goodrich Co., Akron, O. (mail) 1421 Buchanan St., N. W., Washington, D. C.

DOLIAN, FRANK EUGENE (J) research chemist, Commercial Solvents Corp., 1331 S. First St., Terre Haute, Ind.

EKSTROM, CLARENCE E., LIEUT. (SM) U. S. Navy, Patrol Squadron 19, Naval Air Sta., Seattle, Wash.

ELMSLEY, C. M. R., LIEUT. (J) Royal Canadian Ordnance Corps, H.Q.M.D. No. 3, Kingston, Ontario, Canada.

ENGELMAN, ROBERT CHARLES (M) engineering designer, Clark Bros. Co., 600 Lincoln St., Olean, N. Y. (mail) 913 W. Henley St.

ENOCH, OTTO (M) research engineer, Ethyl Gasoline Corp., Research Laboratories, Milwaukee Ave., Detroit, Mich. (mail) 100 Euclid W.

GAMMAGE, C. N. (A) general manager, Hayes Steel Products, Ltd., Merritton, Ontario, Canada.

GASKELL, GEORGE R. (A) vice-president, Winters National Bank & Trust Co., 40 N. Main St., Dayton, Ohio.

GEORGE, GEORGE (FM) technical adviser, Angus & Robertson, Ltd., G.P.O. Box 1516 DD, Sydney, Australia (mail) G.P.O. Box 640 FF.

GRABOW, EDWARD OTTO, JR. (J) Carrier Air Conditioning, South Geddes St., Syracuse, N. Y. (mail) 758 W. Onondaga St.

HALL, ARCHIBALD M. (M) president, Hall-Aluminum Aircraft Corp., Radcliffe St., Bristol, Pa.

HAMMOND, DEAN BURT (M) vice-president, general manager, Stearman-Hammond Aircraft Corp., Bayshore Highway, South San Francisco, Calif. (mail) 1105 Bernal Ave., Burlingame, Calif.

HART, THOMAS JAMES (J) 132 W. 61st St., New York.

HIETT, MURTEN G. (A) chief supervising mechanic, Region 5, U. S. Forest Service, Government Island, Oakland, Calif.

KIBIGER, ARTHUR HENRY (M) auto body stylist, Hudson Motor Car Co., 12601 E. Jefferson Ave., Engineering Bldg., Detroit.

LANG, WALTER GORDON (FM) service representative, General Motors – Holden's Ltd., Wickham St., Brisbane, Queensland, Australia.

LARSSON, ERIK LAMBERT (FM) owner, general manager, L. A. Larssons Gjuteri & Mek. Verkstad, Kristinehamn, Sweden.

LUND, JAMES K. (M) chief engineer, Dole Valve Co., 1901 Carroll Ave., Chicago (mail) 622 S. Taylor Ave., Oak Park, Ill.

LUXMOORE, EMERSON JOHN (M) assistant project engineer, passenger car bodies, Chevrolet Motor Co., General Motors Bldg., Detroit, Mich.

LYNCH, OSCAR P. (M) assistant superintendent transportation, Humble Oil & Refining Co., Room 122, Humble Bldg., Houston, Tex.

MAGNUSON, CARL J. (A) service manager, electrical and radio department, Fields Motor Car Co., 107 S. E. Grand Ave., Portland, Ore.

MCLEOD, MILTON KENNETH (J) research engineer, Waukesha Motor Co., Waukesha, Wis. (mail) 132½ W. Broadway.

MILLER, J. J. (A) auto engineer, General Petroleum Corp. of Calif., Seattle, Wash. (mail) 1519 Alaskan Way.

MILLER, LESLIE T. (M) field engineer, Wright Aeronautical Corp., Paterson, N. J.

NYLANDER, ERNEST R. (A) vice-president, general manager, Baker Equipment Engineering Co., Richmond, Va. (mail) Box 1391.

PURVIN, BENJAMIN ROBERT (M) engineer machine tool division, Barber-Colman Co., Rockford, Ill. (mail) 406 Rome Ave.

RICHARDSON, PAUL H. (J) experimental engineer, Bendix Products Corp., South Bend, Ind. (mail) 1429 E. Miner St.

SCOTT, VERNON L. (A) sales engineer, W. H. Barber Co., Box 630, Minneapolis, Minn.

SMITH, LAWRENCE H. (M) engineer, charge of coach body department, General Motors Truck & Coach Division, Yellow Truck & Coach Mfg. Co., South Blvd. Plant, Pontiac, Mich.

TYLER, SIDNEY LINCOLN (A) chairman of di-

rectors, McIntosh Motors, Pty., Ltd., Adelaide St., Brisbane, Australia (mail) 17 Castlereagh St., Sydney, N.S.W., Australia.

WELLS, LELAND E. (M) chief engineer, Willard Storage Battery Co., 246 E. 131st St., Cleveland, O.

WHITCAMP, HENRY PAUL (A) civilian assistant, motor transportation, U. S. Army, War Dept., Headquarters 6th Corps Area, Quartermaster Office, Room 1050, P. O. Bldg., Chicago, Ill.

WILSON, ERNEST EMERSON (M) technical assistant to director, General Motors Proving Ground, Milford, Mich.

YOUNG, MELVIN RICHARD (J) service representative, Pontiac Motor Division, General Motors Sales Corp., Transportation Bldg., Washington, D. C.

Applications Received

The applications for membership received between Dec. 15, 1937, and Jan. 15, 1938, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

BARKER, ORRIN W., development engineer, Kearney & Trecker Corp., Milwaukee, Wis.

BEATTY, GEORGE A., Pontiac Experimental Engineering Co., Pontiac, Mich.

BELSKY, JACK, inspector, Brooklyn Bus Corp., Brooklyn, N. Y.

BERRY, CARL MARSTON, sales engineer, Ethyl Gasoline Corp., Kansas City, Mo.

BOGREN, NEAL E., president, Waltham Automotive Corp., Waltham, Mass.

BOLT, JAY A., instructor, University of Michigan, Ann Arbor, Mich.

BRADLEY, DAN T., chief engineer, Harris Products Co., Detroit, Mich.

BRAY, ULRIC B., assistant manager research, Union Oil Co. of California, Wilmington, Calif.

BROMBERG, BEN G., junior engineer, Grumman Aircraft Engineering Co., Bethpage, L. I., N. Y.

BROWN, PAGE, western representative, DeLuxe Products Corp., Seattle, Wash.

BUKOFF, PETER, engineer, Barkley-Grow Aircraft Corp., Detroit, Mich.

BURSTEIN, ADOLPH, stress analyst, Seversky Aircraft Corp., Farmingdale, N. Y.

BURT, FRED C., president, Vagabond Coach Mfg. Co., New Hudson, Mich.

CALLAHAN, JAMES C., JR., foreman of repair, Agencia Dodge Y. International, Columbia, S. A.

CARMICK, LOUIS GRANDIN, JR., head, patent department, Evans Products Co., Detroit, Mich.

CAUDEL, FRED H., research engineer, Shell Oil Co., Martinez, Calif.

CLOUD, GOULD H., Standard Oil Development Co., Elizabeth, N. J.

COLLINS, MERRITT E., laboratory manager, Ethyl Gasoline Corp., New York City.

COX, JOHN R., director of manufacturing, Thompson Products, Inc., Cleveland, O.

CUMMINGS, ROBERT E., engineer, Thompson Products, Inc., Cleveland, O.

CUSACK, WALTER M., district sales manager, American Chain Division, American Chain and Cable Co., Bridgeport, Conn.

DAVIS, WALLACE H., superintendent of garage, Village of Winnetka, Winnetka, Ill.

DODDS, EDWIN MATHIESON, engineer, Anglo American Oil Co. Ltd., London, S. W. 1, England.

EARLE, C. E., senior chemical engineer, U. S. Navy, Bureau of Aeronautics, Washington, D. C.

EDINGTON, JACK L., salesman, Thompson Products, Inc., Detroit, Mich.

EDWARDS, HERBERT C., chief engineer, Timken Roller Bearing Co., Canton, O.

ENGEMANN, HERBERT H., engineer, Thompson Products, Inc., Cleveland, O.

ENSINGER, RAY L., designer, Chandler Groves Co., Detroit, Mich.

FARR, WILLIAM W., engineer, National Stamping Co., Detroit, Mich.

FORREST, FRANK D., research engineer, Standard Oil Co. of Calif., Richmond, Calif.

FRASER, ALEXANDER GEO., assistant manager, Republic Supply Co. of California, Los Angeles, Calif.

GAYLORD, JOHN L., garage foreman, Market Street Railway Co., San Francisco, Calif.

GLEASON, JAMES W., engineering instructor, Borough of Dun Ladghaire, Vocational Education Committee, Dublin, I. F. S.

GOULDTHORPE, HUBERT W., mechanical design, General Electric Co., Erie, Pa.

GREEN, DANIEL H., service manager, National Carbon Co., Inc., New York City.

GRIFFITH, WILLIAM A., fleet superintendent, Friend Bros., Inc., Melrose, Mass.

HAGEN, KARL ROBERT, chief draftsman, Timken Roller Bearing Co., Canton, O.

HAINES, ROWLAND I., traffic manager, charge of maintenance, Camden Lime Co., Camden, N. J.

HALL, EMERY L., engineer, Petroleum Heat & Power Co., Cambridge, Mass.

HARFORD, ARTHUR JAMES, automotive engineer, Alba Petroleum Co. of Australia Pty. Ltd., Melbourne, Australia.

HASSEL, ALOYSIUS N., superintendent of repairs, Bailey-Buick Co., Lakewood, O.

HASTY, ALBERT F., engineer, Spicer Mfg. Corp., Toledo, O.

HEADDEN, B. BARTLETT, vice-president, Motor Improvements, Inc., Newark, N. J.

HENGEL, FRED, JR., body drafting, Fisher Body Corp., Royal Oak, Mich.

HIGGINS, HORACE RICHARD, JR., mechanical engineer, National Bureau of Standards, Washington, D. C.

HILL, PAUL R., instructor, Polytechnic College of Engineering, Oakland, Calif.

HOERTZ, NORMAN, engineer, Thompson Products, Inc., Cleveland, O.

HORNER, HENRY G., chief inspector, Chrysler Motors Corp., Detroit, Mich.

HORRIDGE, R. G., Southwestern Bell Telephone Co., St. Louis, Mo.

HUGHES, RICHARD CHARLTON, development engineer, Humber Hillman Co. Ltd., Coventry, England.

HUNT, GORDON, body draftsman, Fisher Body Corp., Detroit, Mich.

HUNTOON, CHARLES H., JR., sales engineer, Norma Hoffmann Bearings Corp., Stamford, Conn.

INNES, J. S., president, J. S. Innes, Ltd., Toronto, Ont., Canada.

JOHNSON, ARTHUR F., automotive engineer, Ethyl Gasoline Corp., N. Kansas City, Mo.

JOHNSON, PAUL C., vice-president, Sealed Power Corp., Muskegon, Mich.

KESEMANN, WILLIAM, partner and engineer, Wilson-Kesemann Engineering Co., Ventura, Calif.

KLINE, JOHN E. G., chief engineer, Micromatic Hone Corp., Detroit, Mich.

LAKE, CROMPTON JOHN, director, Messrs. Lake & Elliot, Ltd., Braintree, Essex, England.

LOWE, WILLIAM WALLACE, field engineer, Bendix-Westinghouse Automotive Air Brake Co., Detroit, Mich.

MAGILL, SAMUEL B., lubrication engineer, Hyvis Oils, Inc., Warren, Pa.

MAGRUM, GERVASE M., experimental engineer, Houde Engineering Corp., Buffalo, N. Y.

MALKIN, GABRIEL, automotive engineer, Socony-Vacuum Oil Co., Brooklyn, N. Y.

MARTIN, FRED L., foreman, mechanic, Luckenbach S. S. Co., San Francisco, Calif.

MAURER, HERBERT N., production engineer, J. H. Williams & Co., Buffalo, N. Y.

MASSEY, THOMAS L., combustion engineer, Gulf Oil Corp., New York City.

MILLER, HERMAN RUSSELL, development engineer, Firestone Tire & Rubber Co., Akron, O.

MITCHELL, JOHN, manager, alloy bureau, Carnegie Illinois Steel Corp., Chicago, Ill.

MITCHELL, ROY T., Detroit representative, New Process Gear Corp., Syracuse, N. Y.

MOSBY, J. ROBERT, sales manager, Cook Paint & Varnish Co., Detroit, Mich.

MUNDY, HARRY, draftsman, English Racing Automobiles (E.R.A.) Ltd., Bourne, Lincolnshire, England.

OLIVER, HORACE GISMOND, JR., engineering, The M. W. Kellogg Co., New York City.

O'NEILL, BERNARD ANDREW, research engineering assistant, Gulf Research & Development Co., Pittsburgh, Pa.

ORR, PALMER, research engineer, Warner Gear, Division of Borg Warner Corp., Muncie, Ind.

PRIEBE, EDWARD HENRY, supt. of machining, Chrysler Corp., Detroit, Mich.

QUIGLEY, EDWARD JOSEPH, aviation engineer, Firestone Tire & Rubber Co., Akron, O.

READ, CYRIL M., engineer, Stewart Warner Corp., Chicago, Ill.

REESE, SYLVESTER J., engineer, American Automatic Devices Co., Chicago, Ill.

REEVES, LEONARD W., salesman, Thompson Products, Inc., Cleveland, O.

ROBB, ALEX L., vice-president, director of engineering and sales, Jadson Motor Products Co., Bell, Calif.

ROBERTSON, SAMUEL B., president, B. F. Goodrich Co., Akron, O.

RUSSELL, JOHN K., president and general manager, Luber-Finer, Inc., Los Angeles, Calif.

SCHIPPER, JOHN EDWARD, JR., associate editor, Hearst Magazines, Inc., New York City.

SCHULTZ, HARRY G., plant manager, Murray Corp. of America, Ecorse, Mich.

SCHWITZER, LOUIS HENRY, JR., vice-president, Schwitzer-Cummins Co., Indianapolis, Ind.

SHILTON, WILLIAM ERIC, chief of technical department, Ferodo Ltd., Chapel-en-Le-Frith, Stockport, England.

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SAE Papers in Digest

HERE are digests of papers presented at various meetings of the Society.

Some of these papers will be printed in full in the SAE JOURNAL.

Mimeographed copies of *all papers received* will be available, until current supplies are exhausted, at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members, plus 2% sales tax on those delivered in New York City. Orders for mimeographed copies must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York.

SAE National Regional Fuels and Lubricants Meeting— Tulsa, Okla., Sept. 30 and Oct. 1, 1937

The Development of the Diesel Around Oil-Country Problems – *C. L. Cummins, Cummins Engine Co.*

THIS paper presents a general discussion on Diesel engines, particularly in relationship to drilling and pumping problems in the oil field; it touches only lightly on the subject of general applications in other fields.

Particular attention is paid to problems of design affecting the flexibility, simplicity, and reliability of engines for rough oil-country usage. The author's information comes from his experience over a period of several years, covering the actual development of the engine into a satisfactory unit for the service under discussion.

Economic Place of Automotive Oil Engines – *Arch F. Campbell, Waukesha Motor Co.*

FOR conclusions as to the future possibilities of automotive oil engines, the fields and histories of both the oil engine and the gasoline engine are surveyed. By oil engine is meant both the full Diesel engine and the Hesselman oil engine, the latter being a low-compression engine burning Diesel fuel in which a spark-plug is used for ignition. This engine was originated by a Diesel designer as a means of overcoming the problems of the high-pressure engine.

If the oil engine is to replace the gasoline engine in the automotive field, it must equal or better the standards set up by the gasoline engine. These standards are enumerated as quietness, smoothness, reliability, easy starting, high performance, high output per pound, economy, and universal service.

Changes necessary to adapt the Diesel engine to automotive service are given as lighter weight, smaller size, greater acceleration, simplified starting, and interchangeability with existing gasoline engine standards.

The paper devotes most of its space to describing the operating principles and mechanical details of the Hesselman oil engine and the Comet full Diesel engine.

Evolution of Bus-Fleet Maintenance Practices – *Floyd Patras, Southwestern Greyhound Lines, Inc.*

(Paper published in full, pages 566-570, Transactions Section, Dec., 1937, issue.)

Observations on One-Year's Lubrication Experience with Hypoids in the Low-Price Brackets and Related Commentaries (A Non-Technical Paper) – *Robert K. Floyd, Frank Harris Floyd, Inc.*

THIS paper points out that, although reliable hypoid lubrication data have been accumulated during the past dozen years, the use of hypoids in low-priced motor cars is new and introduces some important lubrication aspects.

Where approved hypoid lubricants have been employed, the author reports that virtually no failures have occurred, although he sees trouble ahead unless the public is made more "gear-lubricant conscious."

Some Improvements Relating to Seasonal Gasoline and Lubricating Oil – *R. C. Alden and D. G. Proudfoot, Phillips Petroleum Co.*

A COMPREHENSIVE survey of volatility characteristics of Midwest gasolines, previously reported for 1929 to 1934 inclusive, has been extended up to and including the second quarter of 1937. The outstanding fact demonstrated is the rapidly increasing use of wide

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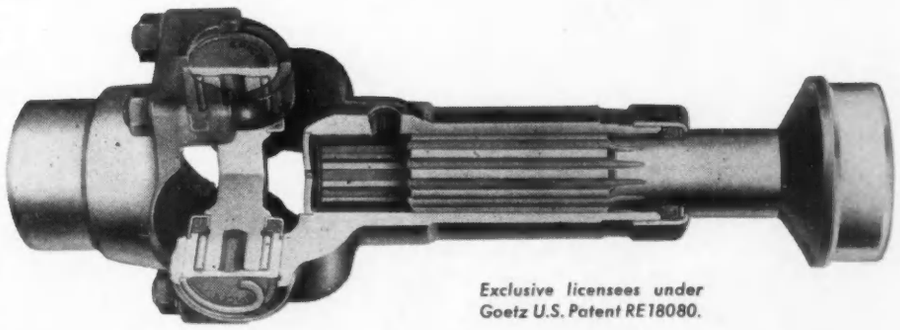

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seasonal variations at the midpoint of the distillation curve. Histories of three major house-brand gasolines are presented to illustrate the point.

Seasonal control of front-end volatility has been practically unchanged for the duration of the survey except for a continuing slow increase in vapor pressure and minor variations in seasonal factors. There are growing evidences of some seasonal control at the 90 per cent distillation temperature.

Except for front-end volatility, premium gasolines are considerably more volatile than house-brand gasolines and exhibit seasonal variations to a greater extent. Third-grade gasolines are considerably less volatile than house-brand gasolines and exhibit no seasonal variations except in front-end volatility.

Climatic studies pertaining to mean minimum temperatures are presented to illustrate their application to putting seasonal oil changes on a calendar basis, thus removing considerable uncertainty as compared with previous practice.

Essentials of Fuel Utilization in Diesel Engines of the Automotive Type – *Robert Best, Continental Oil Co.*

THE purpose of this paper is to bring to the attention of Diesel engine operators the properties of fuels known to be significant.

The problem of igniting the fuel and its relation to ignition quality and to operating conditions are discussed. The possible methods of measuring ignition quality are stated, and those in current use are coordinated.

The relation of ignition quality to efficiency is shown to be slight. The necessity for a high mean effective pressure is discussed, together with the means for its attainment.

Some of the fuel factors influencing proper combustion are given and their effects shown. In this connection, there is also shown the elementary mechanism of atomization.

In conclusion, the dependence of the various variables one to another is explained with the aid of some examples.

Engine Cooling Problems—*F. M. Young, president, Young Radiator Co.*

THE wide range of heat-transfer products involved in engine jacket cooling, in cooling of the engine from the inside by forcing oil to various moving parts of the engine, and in the use of heat exchangers for cooling oil, is classified and described in this paper by means of examples built for various types of automotive vehicles.

Developments of the past few years are pointed out, and design features and materials are related to operating results and production methods. Test methods used in the development of various cooling units are outlined.

In conclusion the paper points out the great similarity in research, design, and arrangement of the wide range of cooling products discussed despite their unrelated appearance, and that still greater improvements may be anticipated.

Bringing the Private Owner's Airplane Up to Date – *Mac Short, The AiRover Co.*

A REVIEW of improvements that have been effected in the past few years in private-owner airplanes is presented in this paper, describing new devices and methods which tend to make the private-owner airplane a better, more efficient, and safer means of transportation.

After classifying various types of private-owner planes with their approximate price ranges, the author discusses developments under aerodynamic, mechanical, and general headings.

National Aircraft Production Meeting—Los Angeles, Oct. 7-9, 1937

Flight-Testing with an Engine Torque Indicator – *A. Lewis MacClain and Richard S. Buck, Pratt and Whitney Aircraft, Division of United Aircraft Corp.*

(Paper published in full, pages 49-62, Transactions Section, this issue.)

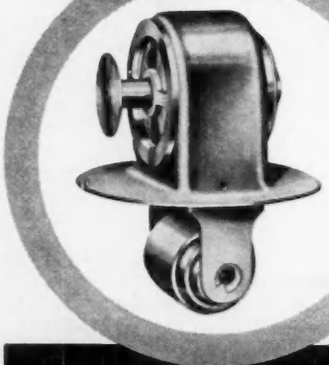
The Design of Cowlings for Air-Cooled Engines – *Donald H. Wood, aeronautical engineer, National Advisory Committee for Aeronautics.*

(Paper published in full, pages 581-595, Transactions Section, Dec. 1937 issue.)

Engine Maintenance From the Operator's Viewpoint – *W. A. Hamilton, Transcontinental & Western Air, Inc.*

THIS paper starts with a brief outline of important changes in design and engineering of present-day transport powerplants compared with those of five years ago. It points out the tremendous increases in take-off horsepower and the changed relation of take-off to cruising

TOPS in MTC
MOTOR TEMPERATURE CONTROL



● The automotive cooling system dissipates heat at a rate largely influenced by the speed of the car—but car speed has no relation to wind and cold weather.

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powers, which indicate the importance from the operator's viewpoint of maintaining engines at higher peak performances than in the past.

The paper then outlines the improved controls and accessories which contribute to improved maintenance and operation, and closes with a tribute to the great advances in design and materials accomplished by engine manufacturers, which advances have made possible the production of engines capable of being maintained in transport operations to satisfy the demands of such outstanding performance.

The Development of Successful Engine Installations – *Robert E. Johnson, Wright Aeronautical Corp.*

REVIEWING the fundamental requirements of satisfactory engine operation and their importance to an efficient combination of airplane and engine, the author points out certain basic needs of the engine which are not apparently understood by the airplane designer, with resulting losses of efficiency to the composite unit.

Engineering For Production in Stainless Steel – *E. J. W. Ragsdale, E. G. Budd Mfg. Co.*

STARTING with considerations which may influence industry to change methods and materials even while in production, this paper proceeds to develop how such a new material should be engineered from the standpoint of design and production. In this discussion the author contrasts wood, dural, and high-tensile steel on the basis of inherent stiffness factors, tells how various factors may be reconciled by design, and then points out the respective merits of each as viewed from the point of view of fabrication. He foresees an eventual switch from the lighter alloys to high-tensile stainless steel, just as there has been a change in the past from wood to the lighter alloys, and he predicates this view upon the basis of production possibilities.

Although the paper is intended primarily for those interested in aircraft production, the argument is based upon the experience gained in the application of stainless steel to light-weight railway equipment, and the assumption is made that this experience may be projected into the field of aircraft production. The author even ventures a suggestion of the different lines along which development should proceed prior to any attempt at production.

Production Control – *Eric Springer, Douglas Aircraft Co.*

THIS paper covers the organization of the Production-Control Department of the Douglas Aircraft Co., with reference to schedules as pertaining to engineering releases, material control and purchasing, airplane breakdown and estimating, individual department control, operation of control booths, scheduling in production departments, purchased parts shortage, rejections, excess production, overstock, completed parts salvage, and orders on engineering changes.

Procurement Planning of the U. S. Army Air Corps – *Major J. L. Stromme, U. S. Army Air Corps.*

IN this paper procurement planning is defined as making all the pre-arrangements necessary to insure effective use of materiel resources in war. These pre-arrangements include such phases as determination of requirements of raw materials, labor, finance, power, transportation, and manufacturing facilities.

The Government's plan for the prompt and effective mobilization of these requirements with special emphasis on the problems of aviation is discussed together with the probable effect of the war load and the measures to be taken to assist industry in absorbing that load.

Quality Control of Aluminum-Alloy Aircraft Castings – *Kent R. Van Horn and Howard J. Heath, Aluminum Co. of America.*

(Paper published in full, pages 4-12. Transactions Section, Jan. 1938 issue.)

The Manufacture, Characteristics, and Uses of Magnesium Castings – *W. G. Harvey, American Magnesium Corp.*

(Paper published in full, pages 43-48, Transactions Section, Jan. 1938 issue.)

Drop-Hammer Applications – *C. R. deLaubenfels, Lockheed Aircraft Co.*

THIS paper gives a brief description of the drop hammer – its processes and possibilities – with some specifications to make for ease of operation and low upkeep. Dies and their manufacture are discussed. Estimates are presented of the approximate cost of drop hammer and die, and the approximate hour cost and piece cost on drop-hammer work. Examples of complicated drop-hammer parts are described.

Six drop-hammer benefits are listed: (1) uniform and interchangeable parts; (2) reduction of number of parts; (3) reduction of fabricating operation; (4) improved strength; (5) decreased weight; and (6) lower cost.

Plastics in Aircraft – *G. P. Young, Röhm and Haas Co., Inc.*

MATERIALS suitable for aircraft construction must possess certain particular properties. As plastics are characterized by two of these properties – low specific gravity and great strength per unit weight – they are of great interest to the aircraft industry.

Plastics are classified as thermosetting and thermoplastic. Each of these classes has certain characteristics which make it suitable for use in aircraft. Molded, laminated, cast, and sheeted plastics have been employed widely in aircraft construction.

The specific applications of plastics in aircraft include such widely varying uses as electrical insulation, dopes, control knobs, and windshields. Each of these applications is discussed. The advantages and limitations of using plastics in aircraft construction are pointed out. Further possible aircraft uses of plastics are described.

Maintenance Problems of Army Airplanes – *Major Joseph T. Morris, U. S. Army Air Corps, chief engineer officer, Rockwell Air Depot, Coronado, Calif.*

THIS paper generalizes on the system and policies of the U. S. Army Air Corps aircraft maintenance. It outlines the responsibility for the inspection and maintenance of the first, second, and third echelons of the service in connection with the overhaul and reconditioning of aircraft and allied equipment.

The problems and difficulties encountered in maintaining as many airplanes as possible in service, with the least interference with the training exercises and maneuver programs of the operating squadrons, are mentioned. The necessity for the Engineering Department of the Depot arranging schedules accordingly in order not to have too many airplanes undergoing overhaul, thereby precluding the operating squadrons from being prepared for any emergency, is pointed out.

The paper comments on the aircraft industry and increased performance of aircraft and engines over the types of previous years. It mentions cost data comparatively on the overhaul and maintenance of the older types to the modern construction.

The point is stressed that cooperation and exchange of ideas among the aircraft industry, manufacturers of allied equipment, the operating and maintenance organizations, whether commercial or military, is the keynote for efficiency and standardization.

Some of the inspection methods, shop practices, and operations used in the United States Army aircraft shops during the overhaul of aircraft and engines, also are covered.

The paper is intended for the purpose of acquainting the aircraft industry, manufacturers of allied equipment, and other aircraft branches of the Government with the system and policy of the United States Army Air Corps maintenance and some of their problems believed to be of current interest.

Ideas in Zinc

Physical and fabricating properties are of controlling interest to engineers, metallurgists, and production men when considering construction materials. In fact, the economic usefulness of such materials is based almost entirely on these characteristics.

Consider, for example, the Bendix Clutch Control Valve Bodies, over a million of which are in use today on modern automobiles. This part has broached bore diameters which are held to hair-splitting accuracy, and the element must function precisely and unfailingly for the life of the car.

Since its introduction, the part has been produced as a zinc alloy die casting. And the reasons for this selection of metal and method are not hard to find. Zinc alloy die castings have superior properties that facilitate the production of intricate shapes with accurately formed cored holes. Although one of the outstanding advantages inherent in such die castings is the elimination of machining operations, their excellent machinability makes such metal cutting as is required most economical to achieve.

The principal requirement of the material used for the Bendix Valve Body, however, is stability. Any change in dimensions or shape of the part must be held to a minimum regardless of operating conditions—changing temperatures, moisture, lubricants, etc. The use of the proper alloy, S.A.E. 903, corresponding to Zamak 3, with a brief, simple heat treatment, meets these and similarly exacting conditions. This is just another indication of the vast field for economy now open to alert manufacturers through the availability of the high strength, stable Zamak Alloys based on Horse Head Special Zinc of 99.99+ per cent purity. The New Jersey Zinc Company, 160 Front Street, New York, N. Y.

Idea No. 9

Effect of Design and Construction on Maintenance and Overhaul of Naval Aircraft – *F. G. Arnold, aeronautical engineer, U. S. Naval Air Station, San Diego, Calif.*

IN safeguarding the reputation of airplanes constructed for the Navy, the designer is faced with the problem of producing a product which may be overhauled with ease and facility, and which must be satisfactory from a maintenance standpoint, in addition to the performance and general characteristics which he constantly strives to better.

In arriving at a design fulfilling the requirements of a propitious overhaul, the designer constantly must keep in mind the necessity of guarding against corrosion by eliminating hazards admitting and holding corrosive agents in contact with parts and by providing proper protective coatings. He should, as far as possible, design parts to permit easy repair and replacement. He should take heed of defects, unforeseen, occurring in service planes, that may be corrected in subsequent design.

The use of non-standards greatly impedes overhaul work and causes confusion in maintaining spare parts stock at overhaul bases, due to the large number of different model airplanes in current use. Simple but complete and legible drawings portraying accurate information, are vitally essential for use in connection with overhaul work, in order that the workmen may interpret readily their meaning and return the airplane to the same degree of perfection possessed when new.

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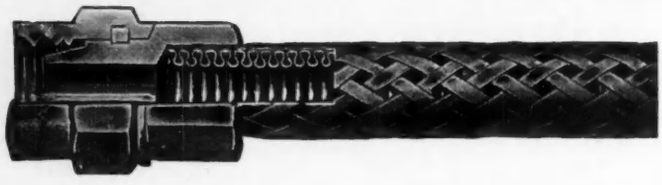

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Factory Equipment and Tooling – *D. M. Carpenter and J. W. Van Doren, Consolidated Aircraft Corp.*

MASS-PRODUCTION methods involving elaborate time studies, single-purpose machines, and costly special tooling are not generally adaptable to the aircraft industry. This condition is because of the extremely varied nature of the work, together with the limited quantities involved. Nonetheless, cost demands for attractive finish and a high degree of interchangeability are insistent and unceasing.

Achievement of reasonable production costs with equipment and tooling lacking in desirable adequacy, meanwhile satisfying the increasingly fastidious demands of customers, presents problems demanding unceasing vigilance, ingenuity, and diplomacy on the part of aircraft factory executives.

European Aircraft Production Equipment – *Henry A. Berliner, president, Engineering & Research Corp.*

THE European aircraft production methods and equipment differing from American practice are described. The machines described include the stretching press for forming large curved surfaces over wooden dies, the Junkers upsetting machine for shrinking sheet metal locally, the wheeling machine for stretching sheet metal and the "Pels" shears for cutting sheet metal to templets.

So. California Section Paper

Sept. 17, 1937

Systematic Tune-Up is Reducing Fleet Operating Costs – *Wallace Linville, test engineer, General Petroleum Co.*

THIS paper stresses the need for periodic motor tune-up if the modern motor car is to fulfill its inherent possibilities of long life and economy in operation. It points out that the goal is to keep the motor functioning as it did originally and give the performance that was paid for initially. Valves, cylinders, carburetion, and ignition are discussed in the light of their potential possibilities for long life, pointing out the care that must be taken to obtain it. Examples from actual fleet operations are mentioned to confirm claims made for longer life and reduced costs through periodic motor tune-up.

Pittsburgh Section Papers

Nov. 16, 1937

Cab-Astride Trucks – *Murray Fahnestock, Ford Dealer and Service Field.*

THIS paper tells of the change in the attitude of truck designers that has been brought about by careful analysis of the desires, needs, and complaints of truck users.

Results of this change, such as more leg room, the C.O.E. design with its increased body space, on load capacity and comfort are discussed.

Modern Conditions Demand Modern Trucks – *B. B. Bachman, The Autocar Co.*

AFTER drawing from rich experience to interpret the development of the automotive industry in terms of economic, social, and political consequences, the author differentiates between "engine-under-the-seat" and "cab-over-engine trucks," lists the advantages and disadvantages of each, and discusses their design features.